ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by Georgianna D. Conant, W. L. Emerick, Wanda L. Grimes, J. W. Hosterman, Virginia M. Jussen, Elisabeth S. Loud, S. H. Mamay, Mildred C. Mead, Virginia S. Neuschel, Marie L. Siegrist, H. A. Tourtelot, Dorothy B. Vitaliano, Angelina C. Vlisidis, G. W. Weir, W. S. White, and E. L. Yochelson.

ABSTRACTS

6013 **Ackers, Peter.** Experiments on small streams in alluvium [reply to discussions of paper 3959, 1964]: Am. Soc. Civil Engineers Proc., v. 92, paper 4708, Jour. Hydraulics Div., no. HY2, p. 329–345, illus., tables, 1966.

In reply to numerous discussions of Acker's 1964 paper, a comparison of sediment data and a tabular summary of the important variables in small streams are given. If data do not confirm traditional regime concepts, channels were not in a regime. The possibility of smooth turbulence was rejected; a plot of velocity against depth is added, although correlation is not good. Aker's hypothesis, that erosion by hydraulic shear may be dominated in larger canals by soil slips in banks, is admittedly contentious. Smith's estimated ratio of total load to bed load is a useful addition. In Aker's experiments, water levels were controlled to yield a pre determined slope, and the channel's self selected sediment transport was recirculated. Rough turbulence was due to a rippled bed rather than to grain sizes.—G.D.C.

Adams, J. A. S. *See* Billings, Gale K. 5814

5953 **Adler, Isidore; Rose, Harry J., Jr.** X ray emission spectrography, Chap. 8 *in* Trace analysis, physical methods: New York, Interscience Publishers, p. 271–324, illus., tables, 1965.

X ray spectroscopy ranks favorably with many physical means of performing chemical analysis and its rapid growth has easily paralleled that of optical emission and infrared spectroscopy. While it has not been considered primarily a tool for trace analysis, recent developments in instrumentation and technique are making it very useful for such applications. Trace analysis, both qualitative and quantitative, is of two types of determinations: minor constituents in large samples, and major constituents in minute samples. The former may be converted to the latter by chemical treatment or concentration. This chapter is devoted to the principles of developments in instrumentation and techniques of X ray spectroscopy, and gives examples of application.—G.D.C.

5574 **Al-Khafif, Soud Mostafa.** A study of open channels degradation and corresponding bed roughness [abs.]: Dissert. Abs., v. 26, no. 10, p. 5928, 1966.

5732 **Am. Assoc. Petroleum Geologists; Soc. Econ. Geologists; SEPM.** (Pacific Sections). A tour of the coastal oil fields of the Los Angeles basin in and adjacent to San Pedro Bay, California—Joint annual field trip, Long Beach, Calif., 1966, Guidebook: [Los Angeles, Am. Assoc. Petroleum Geologists, Pacific Section] [8] p., illus., 1966.

This guidebook for an offshore tour by boat consists of oil field statistics, with two maps in pocket. One map shows structure contours, with well locations, cross sections, and composite log of the San Pedro Harbor area and the other details of Recreation Park oil field in the southeast portion of the Long Beach field. G.D.C.

5909 **Am. Soc. Civil Engineers.** (Task Comm.). Abstracted bibliography on erosion of cohesive materials: Am. Soc. Civil Engineers Proc., v. 92, paper 4746, Jour. Hydraulics Div., no. HY2, p. 243–289, 1966.

Numerous canal, stream, and channel stability problems encountered in sediments containing various degrees of cohesiveness demonstrated the need for research information relative to erosion. A canvass of universities, experiment stations, federal and state agencies, and other public, private and foreign sources resulted in this compilation. For information retrieval purposes, the key words that are cited in the EJC Thesaurus of Engineering Terms are underlined.—G.D.C.

5912 **Am. Soc. Civil Engineers.** (Task Force). Nomenclature for bed forms in alluvial channels: Am. Soc. Civil Engineers Proc., v. 92, paper 4823, Jour. Hydraulics Div., no. HY3, p. 51–64, illus., table, 1966.

In collecting the definitions proposed here, the Task Force was limited to bed forms of open channels formed in granular, noncohesive material that has been transported there by flow in the channel. Thus eolian depositional features, bed forms generated by oscillatory water waves or in cohesive materials, and other classes of bed features are not included in the nomenclature presented here. Certain factors in natural channels are considered: when flow is slow or changing rapidly, the bed configuration may be that characteristic of earlier flows; local bed configuration should be related to local depth and velocity rather than to average flow properties of the whole section; and most alluvial channel bed forms are inherently three dimensional, unless the channel is significantly narrower than its characteristic length. Nine forms are defined and illustrated.—G.D.C.

5914 **Am. Soc. Civil Engineers.** (Task Comm.). Sediment transportation mechanics—Initiation of motion: Am. Soc. Civil Engineers Proc., v. 92, paper 4738, Jour. Hydraulics Div., no. HY2, p. 291–314, illus., tables, 1966.

Forces that resist the entraining action of flowing water sediments differ according to grain size and grain-size distribution. For coarse sediments it is weight of the particles; for finer sediments it is mainly cohesion which varies with mineral composition and environment. The problem of determining critical conditions for moving sediments has long been considered; the results of several workers are presented to illustrate the state of knowledge of erosion of cohesive sediments. The fact that the properties of the sediment which determine its resistance to erosion are not completely defined and the lack of a precise manner in which to determine when critical conditions exist can account for much disparity in results of different workers, making it difficult for them to be compared.—G.D.C.

5612 **Amos, Dewey H.** Geologic map of the Golconda quadrangle, Kentucky–Illinois, and a part of the Brownfield quadrangle in Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–546, scale 1:24,000, section, text, 1966.

Exploration and development of vein and bedded replacement deposits in the map area have produced small amounts of fluorspar, barite, and sphalerite from Fredonia Limestone Member of Ste. Genevieve Limestone and Renault Formation (Mississippian). Building stone and road metal have been quarried from the Caseyville, Golconda, and other formations.—M.C.M.

Amstutz, G. C. *See* Zimmerman, R. A. 5842

Anderson, D. M. *See* Mortensen, J. L. 5876

Anderson, Roger Y. *See* Baltz, Elmer H. 5690

Andreasen, G. E. *See* Henderson, J. R. 5601

5651 **Archambeau, C. V.; Bradford, J. C.; Broome, P. W.; Dean, W. C.; Flinn, E. A.; Sax, R. L.** Data processing techniques for the detection and interpretation of teleseismic signals: IEEE Proc., v. 53, no. 12, p. 1860–1884, illus., 1965.

The first in this collection of six papers evaluates the assumption that outputs of seismometer arrays can be added since signals will reinforce while noise is cancelled. The second describes a method utilizing orthogonal expansions of Kautz type to determine spectral and temporal differences between signals and noise; the third, a thermal equilibrium analogy to estimate noise energies in each mode to account

for observed depth and frequency behavior; the fourth, use of multiple and partial coherence functions for resolving noise into propagation components; the fifth, separation of compressional, shear, and surface wave components of signals from seismic noise by recognizing differing polarization properties; and the sixth, the theory of source mechanisms and how methods of detecting and isolating signals can be integrated into an automated signal analysis system.—V.S.N.

5887 **Armstrong, Patricia.** Devils Lake: Earth Sci., v. 19, no. 3, p. 112–115, illus., 1966.

Devils Lake area, Wisconsin, lies on the edge of the driftless area and contains both moraines and unglaciated mountain remnants. Its history is traced from Precambrian volcanism to Pleistocene glaciation, and the drainage changes due to glaciation are described.—E.S.L.

5875 **Arnett, R. A.; Newhouse, T. W.** Ocean-bottom seismograph: IEEE Proc., v. 53, no. 12, p. 1899–1905, illus., 1965.

The ocean-bottom seismograph was developed as a research tool for study of acoustical wave energy at the solid earth-water interface generated by earthquakes or explosive sources. The model described here has been through four years of development and field experiments. It is spherical in form, has a diameter of 40 in., and has been tested successfully to a depth of 24,000 feet. It contains a 3-component seismometer system, a 40-day digital clock of 0.1 sec accuracy, seismic amplifers capable of detecting noise level of 0.1 μv or less, a magnetic tape transport of 30-day recording capacity for signals of <10 c per sec frequency, and internal battery power for all components. The seismograph descends to the desired depth by free fall and is retrieved on sonar code command or by preset time.—V.S.N.

5640 **Arnow, Ted.** (and others). Developing a state water plan—Ground-water conditions in Utah, spring of 1965: Utah Water and Power Board Coop. Inv. Rept. 3, 99 p., illus., tables, 1965.

This report is the second in a series of annual reports that describe ground-water conditions in Utah. Included are individual discussions of the most important areas of ground-water withdrawal in the State during 1964. Water-level fluctuations, however, are described for the period spring 1964 through spring 1965.—W.L.G.

Arrhenius, G. *See* Bonatti, E. 5867

5829 **Arshad, M. A.; Pawluk, S.** Characteristics of some Solonetzic soils in the glacial Lake Edmonton basin of Alberta—[Pt.] 1, Physical and chemical; [Pt.] 2, Mineralogy: Jour. Soil Sci., v. 17, no. 1, p. 36–55, illus., tables, 1966.

Physical and chemical analyses of five black soil profiles, from glacial lake material overlying glacial till and Upper Cretaceous bedrock, were conducted to investigate the mechanics of their genesis. Texture and $CaCO_3$ content are fairly uniform but considerable variation in salt content indicates that restricted drainage played a part in their development. Mineralogical study showed montmorillonite to be dominant in the clay fraction, illite and kaolinite next in abundance, and chlorite in very small amounts. The montmorillonite appears to have resulted from its preferential translocation as well as from chemical transformation of other silicates. Light-mineral analysis showed weathering of feldspar in the sola although no significant differences were noted in the distribution of heavy minerals.—*from* Authors' abstract

Ash, Sidney R. *See* Baltz, Elmer H. 5690

6006 **Aumento, F.** Thermal transformations of stilbite: Canadian Jour. Earth Sci., v. 3, no. 3, p. 351–366, illus., tables, 1966.

Two stilbite samples from Cape Blomidon, Nova Scotia, and Antrim, Ireland, were examined by preliminary DTA and TGA investigations to 1,400°C, followed by high temperature diffractometry. Debye-Scherrer and Guinier techniques were used on cooled samples. Cell parameters and thermal expansion were calculated from diffractometer and crystal data with a computer. The Cape Blomidon sample has

a considerably lower Mg content and higher percentages of Ca, K, and Na; it also contains more water. The dehydration process could be included in the analcite type classification. Stilbite changes to a metastable form of epistilbite at 145°C, and epistilbite at 240°C and 470°C shows two modifications followed by gradual destruction. Silica formed yields β cristobalite and anorthite at 920°C. E.S.L.

Aune, Q. A. *See* O'Brien, J. C. 5847

5789 **Austin, C. F.; Cosner, L. N.; Pringle, J. K.** Shock wave attenuation in elastic and anelastic rock media: Soc. Mining Engineers Trans., v. 235, no. 1, p. 16–31, illus., tables, 1966.

Shock wave attenuation studies made on a spessartite, elastic at moderate stress levels; a diorite, anelastic at moderate stress levels; and a porous scoria indicate that simplified techniques and assumptions widely employed with metallic materials must be used with caution for granular brittle materials. The donor receptor technique for incident pressure determination at the barrier receptor interface appears to be a valid procedure; both free surface velocities and donor receptor tests should be used in studying rock material but data from both must be accepted cautiously; geometric configuration of explosives and specimens affects results; specific shock velocities are constant for each type tested; attenuation capability varies from rock to rock; and general similarity of response of diorite and spessartite to intense shock indicates that anelastic and elastic qualities are overwhelmed by near explosive effects.—V.S.N.

5693 **Averitt, Paul.** Coking coal deposits of the western United States: U.S. Geol. Survey Bull. 1222–G, p. G1–G48, illus., table, 1966.

Twenty-one areas in eight Western States yield coal of varying degree of utility in manufacture of coke. Geology and coal resources of each are summarized briefly. The Raton Mesa region, Colorado and New Mexico, Carbondale field, Colorado, and Sunnyside–Castlegate field, Utah, are important sources of metallurgical coke used by the growing western steel industry. The Wilkeson Carbonado–Fairfax and the Roslyn fields, Washington, and the Kemmerer–Willow Creek field, Wyoming, contain adequate resources of coal that by washing and blending can be made to yield coke approaching in quality that made from coal obtained in the producing fields. Some areas yield coal suitable for manufacture of lower grade coke, and other areas are undeveloped.—*from* Author's abstract

5577 **Baars, Donald Lee.** Pre-Pennsylvanian paleotectonics of southwestern Colorado and east-central Utah [abs.]: Dissert. Abs., v. 26, no. 10, p. 5973–5974, 1966.

5537 **Back, William.** Hydrochemical facies and ground-water flow patterns in northern part of Atlantic Coastal Plain: U.S. Geol. Survey Prof. Paper 498–A, p. A1–A42, illus., tables, 1966.

Within Coastal Plain sediments, proportions of clay, glauconitic sand, and calcareous material are the principal lithologic controls over chemistry of the water. A subsurface body of salt water extends from southern New Jersey through southern Virginia and occupies deposits deeper than 500 feet in the eastern Coastal Plain. The term hydrochemical facies denotes diagnostic chemical aspect of ground water solutions in hydrologic systems. Facies reflect response of chemical processes operating within the lithologic framework and also the water's flow pattern; their distribution is shown on diagrams and maps. Flow patterns of fresh water are controlled by distribution of higher landmasses and by depth to either bedrock or salt-water interface. At shallow depths calcium–magnesium cation facies generally predominate and in deeper formations, sodium chloride predominates.—*from* Author's abstract

5983 **Back, William; Hanshaw, Bruce B.** Chemical geohydrology, *in* Advances in hydroscience, V. 2: New York, Academic Press, p. 49–109, illus., 1965.

A preliminary appraisal is given of the impact of chemical thermodynamics on the study of the chemistry of natural waters. Current studies are concerned primarily with evaluation of major controls on the chemistry, and these are identified through

equilibrium studies in which the geologic and mineralogic environments are described and the significant minerals which control water chemistry identified. Predictions can then be made regarding changes in chemistry of water during withdrawals from the aquifer or artificial recharge operations. Particular emphasis is placed on the effect of clays on water chemistry because of ion exchange and semipermeable membrane behavior. The isotopic composition (particularly carbon, sulfur, hydrogen, and oxygen) of water has been applied to study of flow characteristics of aquifer systems and to the genesis of ground water.—V.S.N.

5730 **Baird, A. K.; McIntyre, D. B.; Welday, E. E.** Soft and very soft fluorescence analysis—Spectrographic and electronic modifications for optimum, automated results, *in* Developments in applied spectroscopy, V. 4—Annual Mid-America Spectroscopy Symposium, 15th, Chicago, Ill., 1964, Proc.: New York, Plenum Press, p. 3–21, illus., tables, 1965.

In the interest of obtaining large numbers of silicate chemical analyses for the granite batholith of Southern California, changes made in a Philips spectrograph are described which yielded optimum results for chemical analyses for elements oxygen through iron. Additional instrumental and electronic modifications are discussed, which increase analytical efficiency and allow use of computer programs to detect and correct for instrumental drift, compute and evaluate calibrations, test standards for contamination, and test replicates of unknowns for precision. In these programs flexibility is emphasized so that details of analytical conditions and statistical tests can be altered to fit particular requirements.—G.D.C.

5614 **Baker, Arthur A.; Calkins, Frank C.; Crittenden, Max D., Jr.; Bromfield, Calvin S.** Geologic map of the Brighton quadrangle, Utah: U.S. Geol. Survey Geol. Quad. Map GQ-534, scale 1:24,000, section, 1966.

5936 **Baker, Claud H., Jr.** The Milnor channel, an ice-marginal course of the Sheyenne River, North Dakota, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B77–B79, illus., 1966.

Earlier geologists regarded the ridges of sand and gravel above the highest beach of glacial Lake Agassiz in southeastern North Dakota as evidence for a glacial lake that predated Lake Agassiz. They referred to the lake as Lake Milnor and to the ridges as the Milnor beaches. Recent studies indicate, however, that the ridges are part of a much larger deposit of sand and gravel that (1) extends from the Sheyenne River in Ransom County, N. Dak., to the vicinity of Lake Traverse in Roberts County, S. Dak., and that (2) probably was formed in an ice-marginal drainage channel instead of in a lake. It is proposed that the Milnor beaches be renamed the Milnor channel deposits.—Author's abstract

5652 **Baldwin, Richard.** Engineering aspects of multichannel processing based on measured noise correlations: IEEE Proc., v. 53, no. 12, p. 1884–1889, illus., 1965.

Separation of seismic signals from noise on a multichannel basis by using spatial organization of noise is discussed; the method used to synthesize the multichannel system on a computer is described briefly. Results obtained by multichannel processing of outputs from a 19-seismometer array, including signal response, noise response, and signal-to-noise ratio improvement are shown. These results are compared with those obtained by performing a simple summation of the array outputs, and are also compared with those which would be expected from simple summation if noise were not organized in space. A practical method of applying analog multichannel processing in the field is presented, and finally, examples of teleseismic signals extracted on a multichannel basis are shown.—*from* Author's abstract

Ball, Douglas. *See* Ball, Max W. 5816

5816 **Ball, Max W.; Ball, Douglas; Turner, Daniel S.** This fascinating oil business (revised edition): Indianapolis, Ind., Bobbs-Merrill Co., 464 p., 1965; originally published 1940.

In this up-dated book concerning petroleum production and industry for the layman, two of the seventeen chapters are devoted to geology and exploration in theory and practice; one to the composition, origin and products; and two to the history of discovery, exploration, and development in various areas of the old and new worlds. Appendix B contains generalized geologic time tables and sections, and Appendix D summarizes production statistics.—G.D.C.

5690 **Baltz, Elmer H.; Ash, Sidney R.; Anderson, Roger Y.** History of nomenclature and stratigraphy of rocks adjacent to the Cretaceous-Tertiary boundary, western San Juan Basin, New Mexico: U.S. Geol. Survey Prof. Paper 524-D, p. D1-D23, illus., 1966.

Detailed restudy of the Ojo Alamo Sandstone (also called Puerco Formation, Ojo Alamo Beds, McDermott Formation, and upper member of Kirtland Shale) type region, San Juan Basin, northwestern New Mexico, has led to the following revision: the dinosaur-bearing medial shale and lower conglomerate of C. M. Bauer's (1916) Ojo Alamo Sandstone is named the Naashoibito Member of the Kirtland Shale, Montanan age; the name Ojo Alamo Sandstone is restricted to the upper conglomerate of Bauer's Ojo Alamo and classified as Paleocene. The restricted Ojo Alamo Sandstone of the type locality is the sandstone of most other workers in the western, southern, and eastern Central basin of the San Juan Basin and rests with angular unconformity on Montanan rocks. The Cretaceous-Tertiary boundary in the northern and northeastern basin has not been established precisely.—V.S.N.

5854 **Bandy, Orville L.** Restrictions of the "*Orbulina*" datum: Micropaleontology, v. 12, no. 1, p. 79-86, illus., 1966.

The "*Orbulina*" datum is probably a dependable time line at the base of the Burdigalian in deposits of deep-water origin within tropical and warm-temperate areas. "*Orbulina*" developed in post-Burdigalian time in temperate areas. Faunal evidence and potassium-argon dates corroborate the approximate correlation of the Saucesian Stage of California with the Burdigalian Stage of Europe. "*Orbulina universa*" is shown to be a final spherical chamber associated with different species and genera of globigerinids.—Author's abstract

Barclay, C. S. Venable. *See* Wanek, Alexander A. 5692

5772 **Bardwell, George E.** Some statistical features of the relationship between Rocky Mountain Arsenal waste disposal and frequency of earthquakes: Mtn. Geologist, v. 3, no. 1, p. 37-42, illus., tables, 1966.

Some aspects of the statistical problem of relating frequency of earthquakes in the Denver area to injection of waste water by the Rocky Mountain Arsenal are discussed. Behaviour of cumulative time series for earthquake frequency and volume of water are analyzed. A regression-correlation analysis leads to an exponential model approximating the relationship between these two variables. Also considered are statistical tests of the differences in mean number of earthquakes per month for three periods of waste injection.—Author's abstract

5629 **Barnes, Farrell F.** Geology and coal resources of the Beluga-Yentna region, Alaska: U.S. Geol. Survey Bull. 1202-C, p. C1-C54, illus., tables, geol. map, 1966.

The Beluga-Yentna region, embracing the northwestern part of the Cook Inlet Tertiary basin of south-central Alaska is a broad lowland covered by glacial and alluvial deposits but believed to be underlain principally by the coal-bearing Kenai Formation; several isolated mountain masses of Mesozoic bedded and intrusive rocks rise from the lowland. Tertiary rocks consist of interbedded claystone, siltstone, sandstone, and conglomerate, and many coal beds. Conglomeratic sequences in the southwest and northwest are considered to be upper and basal members of the Kenai Formation. Strong folding and faulting of the Kenai is limited to areas adjacent to parts of the mountain front and to Castle Mountain fault zone. Estimated coal reserves total 2,400 million tons of subbituminous B to lignite rank.—*from* Author's abstract

5926 **Barnes, Robert H.; Lounsbury, Richard E.** Geologic map of the Lawrenceburg quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 52-NE, scale 1:24,000, separate text, 1965.

The text, "Mineral resources summary of the Lawrenceburg quadrangle, Tennessee" by R. A. Miller, is cited separately.—M.C.M.

5827 **Barry, G. S.; Gait, R. I.** Geology of the Suwannee Lake area (64C/1), Granville Lake mining division, Manitoba: Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 64-2, 46 p., illus., tables, geol. map, 1966.

In this map-area, southeast of Granville Lake in northwestern Manitoba, bedrock is Precambrian and has been divided into five subdivisions: Wasekwan Series; pre-Sickle Series; Sickle Series; granulites, schists, and gneisses; and intrusive rocks, all metamorphic except the latter. A petrographic study and modal analyses of the rocks are reported. Recognition of the Wasekwan and Sickle Series this far to the east, and the presence of volcanic rocks near the base of the Sickle are major changes from previous mapping. Conclusive evidence for an unconformity between the Wasekwan and Sickle Series was not found. Beds along the south shore of Granville Lake form part of a limb of a large overturned fold. The main folds trend east-southeast and cross folds are present. The area has been prospected for sulfides.—E.S.L.

5644 **Barshad, Isaac.** Thermal analysis techniques for mineral identification and mineralogical composition, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 699-742, illus., tables, 1965.

Thermal analysis techniques may be divided into three broad groups, those that measure changes in weight from loss or gain in gaseous substances, those that measure energy changes, and those that measure changes in the solid phase. Discussion of special apparatus for DTA analysis is divided into the basic requirements and automation. Much of the explanation on procedure is devoted to calibration for temperature or clay-mineral content or species. The section on interpretation of results is divided into DTA curves for 2:1 minerals, and for 1:1 and 2:2 minerals. These are illustrated. The principles of thermogravimetric analysis are explained and methods for crystal-lattice water and organic matter, and integral and thermogravimetric curves described. By combining various methods a complete quantitative determination of minerals in a soil clay fraction can be obtained. Five examples of calculations are given.—E.S.L.

Basler, J. A. *See* Dinwiddie, G. A. 5990

Bateman, P. C. *See* Kistler, R. W. 5543

5853 **Bates, Robert G.** Natural gamma aeroradioactivity map of the Pittsburgh area, Pennsylvania, Ohio, West Virginia, and Maryland: U.S. Geol. Survey Geophys Inv. Map GP-555, scale 1:250,000, text, 1966.

Some correlation between geology and aeroradioactivity data was noted in the southeastern corner of the survey area, where radioactivity units having northeasterly trend reflect the general trend of Appalachian structure. Glacial deposits of Illinoian age to the north have an average radioactivity level of 500 cps; those of Wisconsin age an average of 400 cps, which is intermediate between 350 cps for Mississippian rocks and 500 cps for Pennsylvanian rocks.—M.C.M.

Bayhi, J. F. *See* Levin, F. K. 5972

5788 **Beals, Harold L.** Manganese iron concretions in Nova Scotia lakes: Maritime Sediments, v. 2, no. 2, p. 70-72, illus., 1966.

The floors of six lakes and one harbor between Halifax and Ship Harbour were investigated for concretions by SCUBA divers. The concretions are dark, and friable when dry; sizes range from a few cm across to 25 cm. Theories favoring both

biological and chemical origin have been proposed (Kindle, 1935; Manheim, 1965). The chemical and physical properties were investigated in detail of three areas of concretions showing small differences of shape in Lake Charlotte. No conclusions are drawn from the data obtained as to origin of the concretions. Similar detailed studies are planned for the continential shelf and deep sea. Attempts will be made to grow concretions in the laboratory.—E.S.L.

Béland, J. *See* Lajoie, J. 5774

Bender, Gordon L. *See* Fletcher, Joel E. 5917

6007 **Bennett, A. J.** Two indicator systems for groundwater piezometers: Soil Sci., v. 101, no. 5, p. 392–399, illus., 1966.

Two simple systems for providing a continuous indication of hydraulic pressure or of water level in groundwater piezometers are described with details of their construction, installation, and performance. In the first system, the piezometer is completely filled with water and the upper end coupled to a mercury manometer. The suction registered on the manometer varies inversely with the hydraulic pressure at the lower end of the piezometer. In the second system, an air-filled cylindrical copper chamber with an orifice at the bottom is placed inside the lower end of the piezometer. The pressure transmitted by the head of water inside the piezometer to the air registers above ground on a mercury manometer that is connected to the top of the chamber by narrow-bore copper tubing.—J.W.H.

5563 **Bennion, Douglas Wilford.** A stochastic model for predicting variations in reservoir rock properties [abs.]: Dissert. Abs., v. 26, no. 11, p. 6642, 1966.

Bhappu, Roshan B. *See* Deju, Raul A. 5815

Bidwell, L. E. *See* Cotter, R. D. 5608

5814 **Billings, Gale K.; Ragland, Paul C.; Adams, J. A. S.** Possible rubidium iron covariance in potassium feldspars: Nature, v. 210, no. 5038, p. 829–830, illus., 1966.

The existence of Fe^{3+} in potassium feldspars has been explained by substitution of Fe for Al. Data are presented which indicate a covariance between Rb and Fe (and more significant, between Rb and Fe^{3+} only) in potassium feldspars. It is suggested that the Rb^{1+} ion is larger than the K^{1+} ion and may expand the lattice sufficiently to allow (require?) replacement of an Al^{3+} ion by Fe^{3+}. This is indirectly supported by the fact that the mean concentration of Rb is similar to that of Fe. A possible test would be to examine the spatial relationship of Rb and Fe in potassium feldspars by electron probe microanalysis; spatial covariance of Rb and Fe would be indirect support.—D.B.V.

5928 **Blacet, P. M.** Unconformity between gneissic granodiorite and overlying Yavapai Series (older Precambrian), central Arizona, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B1–B5, illus., table, 1966.

Granodiorite older than isoclinally folded schists of the Yavapai Series is uniquely exposed in the core of an upfaulted anticline at Brady Butte southeast of Prescott, Ariz. A folded unconformity at the base of the Alder Group of the Yavapai Series is well exposed in an area of about three sq mi, providing the only known exposure of the depositional contact between the older Precambrian Yavapai Series and a still older basement. The herein named Brady Butte Granodiorite predates the Mazatzal revolution, during which the overlying Alder Group was metamorphosed, and represents a plutonic event older than any previously recognized in Arizona. Author's abstract

5597 **Blanchett, Jean; Griscom, Andrew; Vargo, J. L.** Natural gamma aeroradioactivity map of the Seneca and part of the Sterling quadrangles, Montgomery County, Maryland, and Loudoun and Fairfax Counties, Virginia: U.S. Geol. Survey Geophys. Inv. Map GP-564, scale 1:24,000, 1966.

5598 **Blanchett, Jean; Griscom, Andrew; Vargo J. L.** Natural gamma aeroradioactivity map of the Rockville quadrangle, Montgomery County, Maryland, and Fairfax County, Virginia: U.S. Geol. Survey Geophys. Inv. Map GP-565, scale 1:24,000, 1966.

5599 **Blanchett, Jean; Griscom, Andrew; Smith, F. C.** Natural gamma aeroradioactivity map of the Gaithersburg and part of the Sandy Spring quadrangles, Montgomery County, Maryland: U.S. Geol. Survey Geophys. Inv. Map GP-566, scale 1:24,000, 1966.

5600 **Blanchett, Jean; Griscom, Andrew; Smith, F. C.** Natural gamma aeroradioactivity map of the Germantown and part of the Poolesville quadrangles, Montgomery and Frederick Counties, Maryland: U.S. Geol. Survey Geophys. Inv. Map GP-567, scale 1:24,000, 1966.

5808 **Boelter, Don H.** Hydrologic characteristics of organic soils in Lakes States watersheds: Jour. Soil and Water Conserv., v. 21, no. 2, p. 50-53, illus., tables, 1966.

In the northern parts of Minnesota, Michigan, and Wisconsin, organic soils can be found in more than 15,000,000 acres of bogs; nearly 20 percent of the forested area is peat land. Organic soils are associated with high water tables, yet water storage, specific yield, and hydraulic conductivity differ widely among the various types of peats. The hydrologic and physical properties of the various peats are described. The porosity of undecomposed moss peats permits flow of water and retention of only small amounts; the density of decomposed and herbaceous peats does not permit easy flow of water or drainage, and the peats have very little storage capacity.—G.D.C.

5736 **Bolton, Thomas E.** Catalogue of type invertebrate fossils of the Geological Survey of Canada, V. 3: Ottawa, Geol. Survey Canada, 203 p., 1966.

Volume 3 of this catalog contains the remaining groups as of mid-1963 in the Geological Survey of Canada collection not listed in the first two volumes, namely, Arthropoda, worms-scolecodonts, conodonts, Incertae sedis, and an index for all three volumes. Future volumes will cover subsequent additions to the collection and will include representatives of all phyla. The format of this volume is similar to that adopted for the previous two. Extraneous specimens are omitted unless they have a direct bearing on the status of the species.—G.D.C.

5867 **Bonatti, E.; Arrhenius, G.** Eolian sedimentation in the Pacific off northern Mexico: Marine Geology, v. 3, no. 5, p. 337-348, illus., table, 1965.

A sound-reflecting underbottom layer extends over a wide area of the Pacific Ocean floor off Baja California, Mexico. The top consists of a silty clay with a silt fraction of clastic minerals, dominantly quartz, alien to the local province of vulcanism. Investigation of possible sources and transport modes indicates that it was windborne from arid continental areas in the past. Radiocarbon dating of the immediately overlying sediment indicates the age to be more than 40,000 years. The surface of the quartz grains is overgrown by chlorite. A possible origin for this coating by diagenetic transformation of desert varnish is suggested. The composite sediment closely resembles greywacke in texture and composition.—*from* Authors' abstract

Bonatti, E. *See* Lynn, D. C. 5989

5709 **Bonham, Harold F., Jr.** Brief resume of the pre-Quaternary geology of the Lake Lahontan area, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 14-18, illus., geol. map, 1965.

Between Winnemucca and Lovelock, Nev., northeast-trending ranges south of the highway are a structural complex of Paleozoic and Mesozoic rocks; north of the highway and west to Reno, ranges of Mesozoic rocks trend northwest. Both sets of ranges are overlain by Tertiary volcanic rocks with major unconformity. The

pre-Tertiary structural pattern is dominated by low-angle overthrusts with high-angle strike-slip faults; the Cenozoic pattern, in contrast, presents broad flexures and high-angle faulting. Recent research indicates that oblique slip-faults largely along strike, rather than simple normal faults, control the Basin and Range structures. The Walker Lane strike-slip zone extends from Las Vegas to Pyramid Lake, with right-lateral displacement. East of this are northeast-trending left-lateral faults, some active in historic times.—G.D.C.

5660 **Bower, C. A.; Wilcox, L. V.** Soluble salts, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 933-951, tables, 1965.

The term soluble salts refers to the inorganic soil constituents that are appreciably soluble in water. Determination of these consists of two steps: preparation of a soil-water extract, and measurement of its salt concentration. Measurement by electrical conductivity is described. Techniques for calcium and magnesium, sodium and potassium, carbonate and bicarbonate, chloride, and boron are given.—E.S.L.

5741 **Bowie, S. H. U.** Uranium and thorium ore reserves and potential [with French, Russian and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 12, Nuclear fuels—Pt. 3, Raw materials: New York, United Nations, p. 28-33, tables, 1965.

Official estimates of uranium reserves by major producing countries total over a million short tons for 1958, 682,000 for 1961, and 500,000 for 1971. Several reasons for downward revision, other than production are: in the United States drilling was inadequate to delineate ore bodies; in Canada borehole data failed to account for loss of ore due to faulting, lateral thinning, and intersecting dikes; in South Africa grade of ore proved to be less than estimated, and unpredicted faulting was encountered. The Colorado Plateau, Witwatersrand, and Elliot Lake, Canada, total 90 percent of the world's uranium reserves. It is doubtful if the Witwatersrand has a large potential; from the other two there will probably be no difficulty in meeting demands before 1975. Research in radiogeology, geophysical and geochemical exploration for low-cost sources, and methods of upgrading ore should be increased.—G.D.C.

5593 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Natural gamma aeroradioactivity map of the Bangor quadrangle, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP-568, scale 1:24,000, 1966.

5594 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Natural gamma aeroradioactivity map of the Belvidere quadrangle, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP-569, scale 1:24,000, 1966.

5595 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Natural gamma aeroradioactivity map of the Bloomsbury and part of the Easton quadrangles, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP-570, scale 1:24,000, 1966.

5596 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Natural gamma aeroradioactivity map of parts of the Lambertville, Lumberville, and Stockton quadrangles, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP-572, scale 1:24,000, 1966.

Bradford, J. C. *See* Archambeau, C. V. 5651

5743 **Bradley, William C.** Marine terraces on Ben Lomond Mountain, California, *in* Guidebook for Field Confereece I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 148-150, 1965.

Five wave-cut terraces are developed on the seaward flank of an elongated Cenozoic dome, each overlain by marine and nonmarine sediments. Steeper segments of the seaward sloping platforms represent former surf zones; the marine sediments, older near the sea cliff, are like modern beaches, but are unlike modern platform deposits in their thickness, lack of seaward decrease in grain size, and well sorted and

laminated character. *Platyodon* shells from the first terrace, which are older than 39,000 C–14 yr, by uranium–daughter ratios yield an age of 110,000–120,000 yr. Tilting of the Ben Lomond terraces indicates late Pleistocene tectonics. The platforms must have been carved during glacio–eustatic rises in sea level; marine sediments then deposited when sea level was falling.—G.D.C.

5653 **Bradner, H.; Dodds, J.; Foulks, R.** Coherence measurements with time sampling ocean–bottom seismometers: IEEE Proc., v. 53, no. 12, p. 1906–1908, illus., 1965.

Instruments for obtaining simultaneous records of ocean–bottom seismic motion are described. Preliminary ocean–bottom seismic data with two simultaneous three–component instruments indicates that instrument noise and water currents may cause small differences in the detailed spectra. The general features of the spectra, however, appear to be the same from proximate instruments.—Authors' abstract

5538 **Branson, C. C.** Maurice G[oldsmith] Mehl, 1888–1966: Oklahoma Geology Notes, v. 26, no. 5, p. 139–140, portrait, 1966.

Breck, D. W. *See* Flanigen, E. M. 5810

5831 **Brett, Robin.** Cohenite in meteorites—A proposed origin: Science, v. 153, no. 3731, p. 60–62, illus., 1966.

Cohenite . . . is found almost exclusively in meteorites containing from six to eight percent nickel (by weight). On the basis of iron–nickel–carbon phase diagrams at 1 atm and of kinetic data, the occurrence of cohenite within this narrow composition range as a low–pressure metastable phase and the nonoccurrence of cohenite in meteorites outside the range six to eight percent nickel can be explained. Cohenite formed in meteorites containing less than six to eight percent nickel decomposed to metal and graphite during cooling; it cannot form in meteorites containing more than about eight percent. The presence of cohenite in meteorites cannot be used as an indicator of pressure of formation. However, the absence of cohenite in meteorites containing the assemblage, metal plus graphite, requires low pressures during cooling.—Author's abstract

5681 **Briscoe, H. W.; Fleck, P. L.** Data recording and processing for the experimental Large Aperture Seismic Array: IEEE Proc., v. 53, no. 12, p. 1852–1859, illus., 1965.

The history of processing for seismic arrays is briefly reviewed, and the recording and processing requirements of the LASA in contrast to past arrays are summarized. Both the on–line use of the LASA for detection of seismic disturbances and the off–line processing of the data for signal analysis are centered around the use of high–speed digital processing equipment. The on–line processing facilities at the LASA Data Center are described, and the current effort to evaluate processing techniques for use with LASA is discussed.—*from* Authors' abstract

Brittain, J. H. *See* Skjei, R. E. 5993

Bromfield, Calvin S. *See* Baker, Arthur A. 5614

5630 **Brookins, Douglas G.; Brown, Lawrence E.** Sulfur isotopic analyses from Park County, Montana: Econ. Geology, v. 61, no. 3, p. 613–617, illus., table, 1966.

Sulfur isotope ratios from Precambrian gold–arsenopyrite ore deposits in schist have a narrow range and show slight enrichment in the heavier isotope. The ratios suggest a magmatic hydrothermal origin.—W.S.W.

Brookins, Douglas G. *See* Eastwood, Raymond L. 5798

5805 **Brookins, Douglas G.** Some Rb–Sr aspects of the genesis of large granitic pegmatites in areas of regional metamorphism: Kansas Acad. Sci. Trans., v. 68, no. 2, p. 305–310, illus., table, 1965.

The Strickland quarry pegmatite at Collins Hill, Conn., is examined in the light of recent Rb–Sr geochronological studies. The original source of the pegmatite is unknown, but the magma must have had a lengthy pre-emplacement history, evidenced by the high initial Sr ratio, and a complex cooling history, as shown by the fact that wallrock minerals yield lower ages (230 m.y.) than most primary pegmatite minerals (255 m.y.). Some pegmatite minerals also yield low ages, but some late-stage cleavelandites are enriched in excess Sr-87. The samples are described and mineral and whole rock isochrons are drawn and age data tabulated.—E.S.L.

Brookins, Douglas G. *See* Brown, Lawrence E. 5807

Broome, P. W. *See* Archambeau, C. V. 5651

5947 **Brown, C. Ervin.** Phosphate deposits in the basal beds of the Maquoketa Shale near Dubuque, Iowa, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Papee 550-B, p. B152–B158, illus., tables, 1966.

Basal beds of the Maquoketa Shale of Late Ordovician age contain phosphatic fossils, nodules, and pellets. Rapid rock and semiquantitative spectrographic analyses of samples from these beds in the vicinity of Dubuque, Iowa, show as much as 17.7 percent P_2O_5 through a thickness of 3.1 feet. Dolomitic beds 20 to 40 feet above the base of the Maquoketa also contain about 17 percent P_2O_5. The most abundant minor elements in the phosphorite beds are strontium, barium, cerium, copper, and lanthanum. Even though sparsely scattered crystals of sphalerite, galena, and barite are found in these or nearby beds, zinc was not detected, and lead and barium contents are very small. Although the phosphate deposits are thin, their geographic location in the midcontinent farming region favors their use as fertilizer raw material.—Author's abstract

Brown, Lawrence E. *See* Brookins, Douglas G. 5630

5807 **Brown, Lawrence E.; Brookins, Douglas G.** The genetic significance of sulfur isotopic analyses from the Jardine–Crevasse Mountain mining district, southwestern Montana: Kansas Acad. Sci. Trans., v. 68, no. 4, p. 566–574, illus., table, 1965 [1966].

The Jardine–Crevasse Mountain mining district contains the only known economic metal deposits associated with Precambrian rocks in Montana. Previous investigations have indicated that the ores are probably magmatic hydrothermal, that the Crevasse Mountain granite was the source of ore solutions, and that emplacement of the granite ended Precambrian history in the area. The mineralogy, paragenesis, and supergene alteration of the gold-arsenic-tungsten ores are described. Data from sulfur isotope analyses of the ores and sulfur-bearing phases from the country rock are consistent with a magmatic hydrothermal origin for both the ore and disseminated sulfides.—E.S.L.

5740 **Brown, R. J. E.** Permafrost investigations in Saskatchewan and Manitoba: Natl. Research Council Canada Div. Bldg. Research Tech. Paper 193, [47] p., illus., tables, 1965.

A survey of the Prairie Provinces in Saskatchewan and Manitoba has revealed a subdued relief of not more than 2,000 feet and an associated relatively simple permafrost distribution pattern. The northern part of the area has a typical Precambrian Shield terrain of rock knobs and ridges, peat-filled depressions, many lakes; the southern part, on progressively younger, Ordovician to Upper Cretaceous, sedimentary and volcanic rocks, has rolling relief with few outcrops and scattered lakes. Preglacial erosion and Pleistocene glaciation and lake deposits have modified the terrains and bog conditions are widespread. Permafrost occurs only in peat bogs in low areas, covered by dry sphagnum. Depth to permafrost table is between 1 ft 6 in and 5 feet 6 in; permafrost thickness increases northward from 3 inches to 18 feet 3 in.—G.D.C.

5564 **Brown, Walter William.** Geochemistry of selected soil profiles developed on ultramafic rocks, Del Norte County, California [abs.]: Dissert. Abs., v. 26, no. 11, p. 6642–6643, 1966.

5878 **Buddington, A. F.** The Precambrian magnetite deposits of New York and New Jersey: Econ. Geology, v. 61, no. 3, p. 484–510, illus., table, 1966.

Magnetite, magnetite with associated hematite, and magnetite skarns form grossly conformable tabular deposits that have the forms of deformed sedimentary deposits. The host rocks, however, include gneisses of diverse composition and amphibolite. The iron oxides now present are late minerals that have replaced their host rocks. If the iron is primarily of sedimentary origin, the original rocks must have had compositions significantly different from those of known sedimentary iron deposits, even with allowance for significant later modification by hypogene solutions. "An origin by direct contributions and emplacement by magmatic emanations has most support."—W.S.W.

5957 **Buerger, M. J.** The geometry of projections [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., ser. 3, v. 10, nos. 1–4, p. 595–607, illus., table, 1965.

A complete crystal structure can be projected usefully only in a rational direction, although an appropriate portion of a structure, such as a unit cell, can be projected in any arbitrary direction. The plane of the projection can be any plane not parallel with the projection direction, but only the plane normal to the projection direction has undistorted geometry. The geometry of projections parallel to nonaxial directions is discussed with regard to the metric features and the multiplicities of the projected cells as related to the space cell. Finally, the relations between the geometries of sets of three projections are discussed, and from this a graphical method of constructing a projection from any two arbitrary projections is derived.—*from* Author's abstract

5718 **Bull, William B.** The Tumey Gulch fanhead trench, western Fresno County, California, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 137–139, illus., 1965.

In the 40-ft stream channel entrenched into the upper part of the Tumey Gulch fan, thin-bedded mudflow deposits and water-laid clayey sediments are exposed. An average rate of deposition of 1.5 feet per 1,000 yr is indicated for the 900 feet of fan deposits above the Corcoran Clay Member of the Tulare Formation. Deposition on nearby fans was even more rapid. Maps and field evidence show that streams became entrenched between 1875 and 1895, changing in depth from 20 feet in 1921 to 40 feet in 1955, the deepest part gradually moving upstream. The lower reach has a wider floor because of lateral cutting. In the north bank of the Tumey Gulch fanhead trench a large cut-and-filled structure can be seen, representing a former channel almost as deep which traversed a different part of the fan and has a second cut-and-fill structure within it.—G.D.C.

5865 **Bull, William B.** Near-surface subsidence near Chaney Pumping Station in western Fresno County, California, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 137, 1965.

The occurrence of more than 10 feet of near-surface subsidence in ditches of this area leads to two conclusions: rainwater or stream runoff had not percolated below the root zone during deposition of the upper 11–200 feet of certain alluvial fans, where plants have been able to transpire the small amounts of infiltrating water; and compaction of clayey sediments, for a given overburden load, is incomplete if moisture is deficient.—G.D.C.

Bunch, Theodore E. *See* Park, Frederick R. 5901

5906 **Bunker, C. M.; Bush, C. A.** Uranium, thorium, and radium analyses by gamma-ray spectrometry (0.184–0.352 million electron volts), *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B176–B181, illus., tables, 1966.

A combination of graphical- and mathematical-interpretation techniques applied to gamma-ray spectrometer data provides a direct method for measuring uranium and an indirect method for measuring thorium and radium in whole-rock samples. Detection limits with a 200-channel spectrometer system including a 4- by 5-inch NaI crystal, a maximum data-accumulation time of 1,000 minutes, and 400- to 900-gram samples are 1.5 ppm for uranium and 1 ppm for thorium and equivalent radium.—Authors' abstract

5619 **Burchfiel, B. C.** Reconnaissance geologic map of the Lathrop Wells 15-minute quadrangle, Nye County, Nevada: U.S. Geol. Survey Misc. Geol. Inv. Map I-474, scale 1:62,500, separate text, 1966.

The text describes the formations of Precambrian, Cambrian, Ordovician, Silurian, Devonian, and Tertiary age, and Quaternary eolian sand and alluvium. Rock structure is characterized by numerous steep faults and sparse folds; structure in Precambrian and Paleozoic rocks is more complex than that in tuffs and tuffaceous sandstones, suggesting much of the deformation is pre-Tertiary or early Tertiary.—M.C.M.

5754 **Burchfiel, B. C.; Stewart, J. H.** "Pull-apart" origin of the central segment of Death Valley, California: Geol. Soc. America Bull., v. 77, no. 4, p. 439-441, illus., 1966.

The deep central segment of Death Valley, Calif., may be related to strike-slip faulting along the Death Valley fault zone. The trend of the fault zone along the central segment of Death Valley is slightly oblique to the fault trend elsewhere, and strike-slip movement may have caused a "pulling apart" of the two sides of the valley along this obliquely oriented segment of the fault.—Authors' abstract

Burns, Kenneth R. *See* Roberts, Thomas N. 5641

5578 **Burton, Robert Clyde.** Conodonts of the Mississippian System in the Sacramento Mountains, New Mexico [abs.]: Dissert. Abs., v. 26, no. 10, p. 5974, 1966.

Bush, C. A. *See* Bunker, C. M. 5906

Bush, Vincent R. *See* Steinbrugge, Karl V. 5896

5626 **Butler, James Robert; McCauley, Camilla K.** Mineralogy and tenor of South Carolina gold deposits: South Carolina Div. Geology Geol. Notes, v. 9, no. 4, p. 59-69, tables, 1966.

South Carolina has produced gold valued at more than 11 million dollars since production started in 1828, from three types of deposits—quartz-pyrite veins, replacement bodies, and placers. Nearly 40 minerals have been identified from the lode deposits, and are listed. Native gold and gold combined with pyrite are found. Quartz is the commonest gangue mineral, and the others are limited in occurrence and quantity. It appears that some supergene enrichment has taken place in the gold lodes but does not cause a radical change in ore values.—E.S.L.

5894 **Byerly, Perry.** History and technical aspects of the questionnaire program in earthquake investigation, *in* Earthquake investigations in the western United States, 1931-64: U.S. Coast and Geod. Survey Pub. 41-2, p. 203-204, 1965.

A brief history is given of the custom of circulating postcard questionnaires to obtain information on the intensity of earthquakes. The custom developed in California and was taken over by the U.S. Coast and Geodetic Survey in 1925. The various earthquake effects listed on the card are criteria on the Modified Mercalli scale of earthquake intensities and enable the seismologist to rate the intensity of a shock in various parts of the affected region. Moreover, the reports of the effect of earthquakes are of value to the engineer as a guide to construction of earthquake-proof buildings.—V.S.N.

5698 **Cabaniss, G. H; Hunkins, Kenneth L.; Untersteiner, N.** (compilers). US-IGY Drifting Station Alpha, Arctic Ocean 1957-1958: U.S. Air Force Cambridge Research Labs. Spec. Rept. 38 (AFCRL-65-848). 322 p., illus., tables, 1965.

Station Alpha was the first floe-station established and maintained by the United States during the IGY. Disciplines represented in scientific studies of the Arctic Ocean environment were meteorology, ice physics, oceanography, geophysics, geology, and marine biology. Twenty-two papers previously published in professional journals are reprinted here in order to have all the results from Station Alpha under one cover. Contributors cited in earlier bibliographies are K. L. Hunkins, 1959, 1960, 1961, I. Friedman, 1961, and W. Schwarzacher, 1961.—E.S.L.

5675 **Cady, John G.** Petrographic microscope techniques, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 604-631, illus., 1965.

Petrographic microscope techniques for soils are divided into those for use on grains and on thin sections. Heavy-liquid separation and slide preparation for grain study are discussed and detailed criteria given for identifying and differentiating minerals. Microcrystalline aggregates and amorphous substances are included here. Under thin sections, sampling, impregnation, and cutting and finishing techniques are given. Identification of grains and matrix, and morphology studies are described in detail. Twelve color photos are included. A discussion of applications to petrographic soil studies concludes the paper.—E.S.L.

5902 **Cahill, J. M.** Preliminary evaluation of three tracers used in hydraulic experiments on sand models, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B213-B217, illus., 1966.

In studies of movement of fluid through porous material, ion exchange and adsorption of dissolved particles on solids create an apparent delay in the movement of liquids tagged with tracers. In a laboratory study of the effect of tracers on this delay, the breakthrough and elution characteristics of the following three tracer solutions passing through a saturated column of loosely packed sand were compared: (1) radiophosphorus (P^{32}), (2) organic dye in a glycerine base, and (3) sodium chloride. Experimental data showed little difference between the effect of the three tracers on the movement of the fluid when the sand was chemically and physically compatible with the tracers.—Author's abstract

5645 **Caldwell, David K.** A Miocene needlefish from Bowden, Jamaica: Florida Acad. Sci. Quart. Jour., v. 28, no. 4, p. 339-344, illus., 1965.

Fragments of a fish jaw with teeth have been found in the late middle Miocene Bowden Formation at the type locality on the southeast coast of Jamaica, about a mile south of Bowden. This is the first fossil fish reported from Jamaica, and the first vertebrate found in the Bowden fauna, which is rich in invertebrates. The specimen is compared with six species of living western Atlantic Belonidae, of which five have been recorded from Jamaican waters; it is assigned for the present to *Platybelone cf. argalus* (LeSueur). Nomenclature of *Platybelone and Belone*, and ecology of the living *P. argalus* are discussed. References for Eocene to Recent fossil records of Belonidae are given.—V.M.J.

Calkins, Frank C. *See* Baker, Arthur A. 5614

Calvin, L. D. *See* Petersen, R. G. 5668

Cameron, J. F. *See* Payne, B. R. 5848

5980 **Campbell, R. B.; Tipper, H. W.** Geology, Bonaparte River, British Columbia: Canada Geol. Survey Prelim. Ser. Map 3-1966, scale 1:253,440, text, 1966.

Outcrops in the Bonaparte River area are sparse but sufficiently well distributed to permit interpretations of the geological relationships in most places. Paleozoic to Cenozoic map-units are described with references to other research on nearby

map-areas. The combination of several ages of intrusive rocks, volcanic and sedimentary assemblages, extensive fracturing, copper and molybdenum mineralization suggests a potential for mineral exploration. In many aspects the region is geologically comparable to copper producing areas to the south.—M.C.M.

5477 **Canada Geological Survey.** Aeromagnetic map, Crowduck Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 1193, scale 1:63,360, revised 1966; originally published 1962.

5478 **Canada Geological Survey.** Aeromagnetic map, Ryerson Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 1194, scale 1:63,360, revised 1966; originally published 1962.

5479 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 F/4, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3654, scale 1:63,360, 1966.

5480 **Canada Geological Survey.** Aeromagnetic map, Angekum Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3655, scale 1:63,360, 1966.

5481 **Canada Geological Survey.** Aeromagnetic map, Hayward Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3656, scale 1:63,360, 1966.

5482 **Canada Geological Survey.** Aeromagnetic map, Angling Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3657, scale 1:63,360, 1966.

5483 **Canada Geological Survey.** Aeromagnetic map, Red Sucker Lake, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3658, scale 1:63,360, 1966.

5484 **Canada Geological Survey.** Aeromagnetic map, Sharpe Lake West, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3659, scale 1:63,360, 1966.

5485 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 K/12, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3660, scale 1:63,360, 1966.

5486 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 K/13, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3661, scale 1:63,360, 1966.

5487 **Canada Geological Survey.** Aeromagnetic map, Kakapitam Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3662, scale 1:63,360, 1966.

5488 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 F/6, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3663, scale 1:63,360, 1966.

5489 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 F/11, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3664, scale 1:63,360, 1966.

5490 **Canada Geological Survey.** Aeromagnetic map, Seeber Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3665, scale 1:63,360, 1966.

5491 **Canada Geological Survey.** Aeromagnetic map, Robson Lake, Kenora and Winnipeg mining districts, Ontario–Manitoba: Canada Geol. Survey Geophysics Paper 3666, scale 1:63,360, 1966.

5492 **Canada Geological Survey.** Aeromagnetic map, Sharpe Lake East, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3667, scale 1:63,360, 1966.

5493 **Canada Geological Survey.** Aeromagnetic map, Edmund Lake, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3668, scale 1:63,360, 1966.

5494 **Canada Geological Survey.** Aeromagnetic map, Kenyon Lake, Winnipeg mining district, Manitoba: Canada Geol. Survey Geophysics Paper 3669, scale 1:63,360, 1966.

5495 **Canada Geological Survey.** Aeromagnetic map, Flintstone Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4047, scale 1:63,360, 1966.

5496 **Canada Geological Survey.** Aeromagnetic map, Garner Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4048, scale 1:63,360, 1966.

5497 **Canada Geological Survey.** Aeromagnetic map, Aikens Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4049, scale 1:63,360, 1966.

5498 **Canada Geological Survey.** Aeromagnetic map, Artery Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4050, scale 1:63,360, 1966.

5499 **Canada Geological Survey.** Aeromagnetic map, Dogskin Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4051, scale 1:63,360, 1966.

5500 **Canada Geological Survey.** Aeromagnetic map, Family Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4052, scale 1:63,360, 1966.

5501 **Canada Geological Survey.** Aeromagnetic map, Fishing Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4053, scale 1:63,360, 1966.

5502 **Canada Geological Survey.** Aeromagnetic map, Red Willow Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4054, scale 1:63,360, 1966.

5503 **Canada Geological Survey.** Aeromagnetic map, Charron Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4055, scale 1:63,360, 1966.

5504 **Canada Geological Survey.** Aeromagnetic map, Elliot Lake, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 4056, scale 1:63,360, 1966.

5505 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 E/3, Manitoba: Canada Geol. Survey Geophysics Paper 4057, scale 1:63,360, 1966.

5506 **Canada Geological Survey.** Aeromagnetic map, Cantin Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4058, scale 1:63,360, 1966.

5507 **Canada Geological Survey.** Aeromagnetic map, Wass Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4059, scale 1:63,360, 1966.

5508 **Canada Geological Survey.** Aeromagnetic map, Dobbs Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4060, scale 1:63,360, 1966.

5509 **Canada Geological Survey.** Aeromagnetic map, Fairy Rock Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4061, scale 1:63,360, 1966.

5510 **Canada Geological Survey.** Aeromagnetic map, Joint Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4062, scale 1:63,360, 1966.

5511 **Canada Geological Survey.** Aeromagnetic map, Munro Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4063, scale 1:63,360, 1966.

5512 **Canada Geological Survey.** Aeromagnetic map, Oxford House, Manitoba: Canada Geol. Survey Geophysics Paper 4064, scale 1:63,360, 1966.

5513 **Canada Geological Survey.** Aeromagnetic map, Pinawa, Manitoba: Canada Geol. Survey Geophysics Paper 4069, scale 1:63,360, 1966.

5514 **Canada Geological Survey.** Aeromagnetic map, Pointe du Bois, Manitoba: Canada Geol. Survey Geophysics Paper 4070, scale 1:63,360, 1966.

5516 **Canada Geological Survey.** Aeromagnetic map, Manigotagan Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4072, scale 1:63,360, 1966.

5517 **Canada Geological Survey.** Aeromagnetic map, Wanipigow, Manitoba: Canada Geol. Survey Geophysics Paper 4073, scale 1:63,360, 1966.

5518 **Canada Geological Survey.** Aeromagnetic map, Sheet 52 M/5, Manitoba: Canada Geol. Survey Geophysics Paper 4074, scale 1:63,360, 1966.

5519 **Canada Geological Survey.** Aeromagnetic map, Sasaginnigak Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4075, scale 1:63,360, 1966.

5520 **Canada Geological Survey.** Aeromagnetic map, Viking Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4076, scale 1:63,360, 1966.

5521 **Canada Geological Survey.** Aeromagnetic map, Horseshoe Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4077, scale 1:63,360, 1966.

5522 **Canada Geological Survey.** Aeromagnetic map, Carr–Harris Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4078, scale 1:63,360, 1966.

5523 **Canada Geological Survey.** Aeromagnetic map, Lewis Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4079, scale 1:63,360, 1966.

5524 **Canada Geological Survey.** Aeromagnetic map, Gilchrist Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4080, scale 1:63,360, 1966.

5525 **Canada Geological Survey.** Aeromagnetic map, Hudwin Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4081, scale 1:63,360, 1966.

5526 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 E/5, Manitoba: Canada Geol. Survey Geophysics Paper 4082, scale 1:63,360, 1966.

5527 **Canada Geological Survey.** Aeromagnetic map, Bigstone Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4083, scale 1:63,360, 1966.

5528 **Canada Geological Survey.** Aeromagnetic map, Stevenson Lake East, Manitoba: Canada Geol. Survey Geophysics Paper 4084, scale 1:63,360, 1966.

5529 **Canada Geological Survey.** Aeromagnetic map, Kennedy Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4085, scale 1:63,360, 1966.

5530 **Canada Geological Survey.** Aeromagnetic map, Bolton Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4086, scale 1:63,360, 1966.

5531 **Canada Geological Survey.** Aeromagnetic map, Windy Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4087, scale 1:63,360, 1966.

5532 **Canada Geological Survey.** Aeromagnetic map, Carghill Island, Manitoba: Canada Geol. Survey Geophysics Paper 4088, scale 1:63,360, 1966.

5533 **Canada Geological Survey.** Aeromagnetic map, Malakwa, District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4781, scale 1:63,360, 1966.

5534 **Canada Geological Survey.** Aeromagnetic map, Sorrento, District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4782, scale 1:63,360, 1966.

5535 **Canada Geological Survey.** Aeromagnetic map, Chase, District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4783, scale 1:63,360, 1966.

5536 **Canada Geological Survey.** Aeromagnetic map, Heffley, District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4784, scale 1:63,360, 1966.

5996 **Canada Geological Survey.** Aeromagnetic map, Rankin Inlet, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3524, scale 1:63,360, 1966.

5897 **Carder, Dean S.** (editor). Earthquake investigations in the western United States 1931–64: U.S. Coast and Geod. Survey Pub. 41–2, 264 p., illus., tables, 1965.

The development of earthquake research in the United States is reviewed and results of investigations since inception of the U.S. Coast and Geodetic Survey program in engineering seismology in 1931 are summarized. Some of the material presented was first published in 1936 in "Earthquake investigations in California, 1934–36", U.S. Coast and Geodetic Survey Spec. Pub. 201. Papers reprinted essentially intact include one on vibration calculations by R. S. McLean and W. W. Moore, on earthquake damage in Long Beach in 1933 by R. R. Martel, and on analysis of records by Frank Neumann. Revised and new contributions are cited separately.—V.S.N.

6005 **Carder, Dean S.** Vibration observations, *in* Earthquake investigations in the western United States, 1931–64: U.S. Coast and Geod. Survey Pub. 41–2, p. 35–175, illus., tables, 1965.

Material that has appeared in publications on measurements of vibrations in engineering structures by the Coast and Geodetic Survey since 1934 are summarized in tables and discussed. Nearly all vibrations were generated by the wind, and results indicate that the period of structure vibration relative to measured amplitudes has remained fairly constant; special cases of structures forced into resonance by a vibration machine are covered to a limited extent. Studies of ground vibrations indicate that ground is responsive to waves of many periods in the range of building periods. Examination of ground-associated periods from microseisms and other records show that regional characteristics of the ground contribute materially to earthquake spectra and that a dominant period associated with the ground would be a factor influencing response of structures of small internal damping.—V.S.N.

6023 **Carey, Kevin L.** Observed configuration and computed roughness of the underside of river ice, St. Croix River, Wisconsin, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–B, p. B192–B198, illus., table, 1966.

Ripple- and dune-like features on the underside of the cover of river ice on the St. Croix River, Wis., change with time and closely resemble ripples and dunes found on alluvial streambeds. In 12 observations the wavelength and amplitude of the "ice-dunes" averaged about 0.65 ft and 0.07 ft, respectively. In all dune profiles the steeper slopes were on the downstream sides of the features. No suspended sediment or frazil (slush) ice was present in the flow. It is suggested that the features may owe their origin to fluid turbulence. The Manning roughness coefficient, calculated for the underside of the ice by a new method which uses the results of discharge measurements through the ice and supporting field data, is related to the observed characteristics of the underside of the ice.—Author's abstract

Carlson, J. Wendel. *See* Hall, Charles E. 5768

5720 **Carpenter, David W.** Pleistocene deformation in the vicinity of the Mile 18 Pumping Plant, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 142–145, illus., 1965.

Some of the best exposures of deformed Pleistocene sediments occur in steep gullies in the Coast Range foothills near the site of the Luis Canal along the western margin of the San Joaquin Valley. In the foundation excavations deformed outcrops were discovered of the distinctly diatomaceous Corcoran Clay Member of the Tulare Formation, previously identified only in the subsurface, as well as overlying marl and gravelly clay deposited before the deformation. The thickness of Pleistocene

and Recent sediments overlying the Corcoran at Mile 18 is much less than that commonly found elsewhere in the San Joaquin Valley; dips flatten rapidly away from the hills. Structural contours on top of the Corcoran, based on core holes and well logs, show deformation by a northeast plunging anticline. Tectonic movements possibly as late as the Pleistocene are indicated.—G.D.C.

5677 **Carpenter, E. W.** An historical review of seismometer array development: IEEE Proc., v. 53, no. 12, p. 1816–1821, illus., 1965.

The original seismic array designed for detection of nuclear explosions consisted of ten seismometers distributed in an area of a few square kilometers; however, magnetic tape recording and processing has made it possible to use crossed linear arrays with dimensions of a few tens of kilometers. These latter arrays have demonstrated the usefulness of velocity filtering which has led to the concept of a few extremely large and powerful arrays and to establishment of LASA or an array of arrays. Various national networks are cited to illustrate the stages of development.—V.S.N.

5748 **Carr, Jerome B.** Long-term (geotectonic) stress generation, propagation and accumulation in the Earth: Nature, v. 210, no. 5033, p. 239–245, illus., table, 1966.

Investigation of stress in the Earth leads to the conclusions that (1) geotectonic stress generation is due to phase change at two levels in the Earth, at the M discontinuity and in the C region (400–1000 km); (2) geotectonic stress propagation is limited to 53° of arc and is probably rectilinear; (3) stress accumulates in regions above 720 km, and below that is dissipated in some form of plastic flow. Finally, it is concluded that the entire geotectonic spectrum of stress relief may be explained by the stress generation, propagation, and accumulation as described here, and that convection currents are not needed to explain any geotectonic phenomenon.—D.B.V.

6002 **Carr, Michael H.** Measurement of the velocity of high-amplitude shock waves in rock materials by means of strain gages, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B99–B103, illus., table, 1966.

Shock waves, ranging in amplitude from 10 to 150 kilobars, were generated in rock materials with C-4 explosives. To measure the speed of a shock wave, SR-4 strain gages were placed at different positions along the path of the shock wave. The signals emitted by the gages on arrival of the shock wave were recorded on an oscilloscope so that the time interval between successive gage signals could be calculated. From this time interval the shock speeds were determined. In some instances an elastic wave arrived at the gages before the shock wave so that the elastic-wave velocity was measured instead of the shock-wave velocity. The measured speeds in specimens of the Coconino Sandstone ranged from 2.9 to 4.2 km/sec, in a sandstone from the Moenkopi Formation from 2.5 to 2.9 km/sec, in a basalt from 5.5 to 6.0 km/sec, and in Yule marble from 2.3 to 5.2 km/sec.—Author's abstract

5844 **Carroll, Roderick D.** Rock properties interpreted from sonic velocity logs: Am. Soc. Civil Engineers Proc., v. 92, paper 4715, Jour. Soil Mechanics and Found. Div., no. SM2, p. 43–51, illus., table, 1966.

With the recent introduction of a wide variety of shallow hole devices, the addition of inhole geophysical logging to the tools of the geophysical engineering consultant is imminent. The relationships found among pertinent rock properties and sonic velocity log in sedimentary and volcanic rocks in a series of holes drilled on Amchitka Island in the Aleutians, illustrate how geophysical logging can supplement, or supplant, coring in areas of subsurface engineering interest. Rocks penetrated consist of Tertiary submarine and subaerially deposited clastic volcanic material containing intrusive basaltic andesite. Comparisons are made of the sonic log with lithology, breaking stress, sonic traveltime, and compressive strength.—G.D.C.

Chase, Edith Becker. *See* Mesnier, Glennon N. 5605

5762 **Chatterjee, B. K.** New technique for preparing polished thin sections of heavy mineral residue: Jour. Sed. Petrology, v. 36, no. 1, p. 268–269, illus., 1966.

A thermosetting plastic having differential thermal contraction is a convenient mounting medium for making polished thin sections of heavy mineral grains. H.A.T.

5699 **Chen, Chih Shan.** The regional lithostratigraphic analysis of Paleocene and Eocene rocks of Florida: Florida Geol. Survey Geol. Bull. 45, 105 p., illus., 1965.

Lithologic and thickness data obtained from cuttings, cores, and electric logs of 164 selected wells were used in constructing isopach–lithofacies and structure maps, and cross sections for the early Tertiary of Florida. Two distinct facies, clastic and nonclastic, are differentiated, which were separated by the Suwannee Channel until the end of the Eocene. Interpretations of regional sedimentation include an environment in peninsular Florida comparable to the Great Bahamas or Campeche Bank, while in the Panhandle clastic sediments were laid down on an unstable shelf. Stratigraphic analysis indicates only epeirogenic movements during the early Tertiary. Paleogeographic maps for the successive stratigraphic units are included.—E.S.L.

Chen, T. S. *See* Marovelli, R. L. 5791

5855 **Church, W. R.** Structural evolution of North East Newfoundland—Comparison with that of the British Caledonides [summ.]: Maritime Sediments, v. 1, no. 3, p. 10–11, 1965.

5999 **Cloud, William K.** Instruments for earthquake investigation, *in* Earthquake investigations in the western United States, 1931–64: U.S. Coast and Geod. Survey Pub. 41–2, p. 5–20, illus., table, 1965.

Instruments for earthquake investigations currently in use and some now becoming obsolete are described. The C and GS strong-motion seismograph and its key components—the pendulum starter, accelerometer, displacement meter, and timing device; the Weed seismograph, less expensive and less accurate than the C and GS seismograph but still in limited use; the seismoscope, the latest instrument developed by the Coast and Geodetic Survey and measuring a single point on a spectrum; various vibration meters to measure periods of structures; and the tiltmeter are described and illustrated. Strong-motion stations in the western United States are listed.—V.S.N.

6008 **Cloud, William K.** The cooperative program of earthquake investigation, *in* Earthquake investigations in the western United States, 1931–64: U.S. Coast and Geod. Survey Pub. 41–2, p. 3–4, 1965.

A cooperative program for study of engineering aspects of seismology was instituted in California in 1934 by various Federal government bureaus and university personnel. Results in 1936 included the following: a questionnaire program for study of earthquake intensity, enlargement of strong-motion seismograph network to 51 instruments, study of vibration periods of 292 structures, development of the first ground and building vibrator, analysis of damage to type III masonry buildings during the Long Beach earthquake of 1933, recording of ground periods in routine teleseismic instrument operations, and double integration of strong-motion acceleration records. Developments since have included an expansion and refinement of these accomplishments in areas outside of California. The application of strong-motion and other data to engineering needs has become a major function of the Coast and Geodetic Survey.—V.S.N.

5846 **Coates, D. F.** Rock mechanics principles: Canada Dept. Mines and Tech. Surveys Mines Br. Mon. 874, [338] p., illus., 1965.

In this guide for the young engineer or scientist, emphasis is on application of engineering mechanics to problems arising from the needs either to prevent or to cause rock failure, especially in mining. Various important theories in mechanics and rock properties are reviewed for background information. The main groups

of rock problems examined in separate chapters are: elastic prototypes; shafts, drifts and tunnels; pillars; stopes, caving and subsidence; rock slopes; foundations; and rock dynamics. The quantitative statistical expression of the dispersion of material properties enables decisions to be made on the degree of risk to be taken; but for prediction with certainty comparative analyses still can be valuable, and experience and good judgment are invaluable.—G.D.C.

5777 **Coats, Donald R.** Glaciated Appalachian Plateau—Till shadows on hills: Science, v. 152, no. 3729, p. 1617–1619, illus., 1966.

North slopes are twice as steep as south slopes on the hills of central New York. This asymmetry is caused by unequal till thickness—3.6 m on north slopes and 27.6 m on south slopes. Previous workers interpreted the hills as being of bedrock sculpture by glacial erosion, with till 0.9 to 3 m thick.—Author's abstract

Cobban, William A. *See* Gill, James R. 5932

5565 **Cohen, Lewis Hart.** Melting and phase relations in an anhydrous basalt to 45 kilobars [abs.]: Dissert. Abs., v. 26, no. 11, p. 6643, 1966.

5555 **Cohen, Philip.** Water in the Humboldt River valley near Winnemucca, Nevada: U.S. Geol. Survey Water-Supply Paper 1816, 69 p., illus., tables, 1966.

Average annual inflow to the storage area in the Winnemucca reach of the Humboldt River valley in 1949–62 was about 250,000 acre-feet; of this 71 percent was streamflow, 23 percent direct precipitation, and 6 percent ground-water inflow. Increased ground-water development could decrease flow of the Humboldt River and cause further problems. Study results indicate the Humboldt River and ground water in the unconsolidated deposits beneath and adjacent to the river in the study area are closely related; and procedures should be evaluated for use in nearby areas of the basin. Water quality is discussed.—M.C.M.

Colhoun, Eric A. *See* Cruickshank, James G. 5994

5908 **Collinson, D. W.** Carrier of remanent magnetization in certain red sandstones: Nature, v. 210, no. 5035, p. 510–517, illus., table, 1966.

The remanent magnetization of 10 red and purple sandstones ranging in age from Jurassic to Precambrian, 9 of them from western North America and the other from Bolivia, was measured before and after dissolving away the pigment. The results indicate that the pigment and specularite in red sandstones can both contribute to the natural remanent magnetization. In some cases at least, the pigment contributes most if not all of the remanence.—D.B.V.

5613 **Colton, Roger B.; Hartshorn, Joseph H.** Bedrock geologic map of the West Springfield quadrangle, Massachusetts and Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-537, scale 1:24,000, section, 1966.

5579 **Condie, Kent Carl.** Petrology and geochemistry of the late Precambrian rocks of the northeastern Great Basin [abs.]: Dissert. Abs., v. 26, no. 10, p. 5974–5975, 1966.

Conklin, Nancy M. *See* Staatz, Mortimer H. 5943

Conwell, F. R. *See* Skjei, R. E. 5993

Cook, Kenneth L. *See* VanNostrand, Robert G. 5880

5770 **Corbett, Marshall K.** The geology and structure of the Mt. Richthofen–Iron Mt. region, north central Colorado: Mtn. Geologist, v. 3, no. 1, p. 3–21, illus., 1966.

The Mt. Richthofen–Iron Mtn. area is characterized by Tertiary igneous activity; a complex rock series was emplaced that is consistent with basalt–andesite–rhyolite association of orogenic belts. Never Summer stock intrudes Precambrian crystalline and Permian–Cretaceous sedimentary rocks; associated volcanic deposits vary from

basalt to rhyolite. Mafic varieties comprise the Cameron Pass Volcanics and belong to an Eocene(?) volcanism; Specimen Mountain Volcanics are younger and the most extensive volcanic material. K–Ar ages of silicic rocks correspond to the Oligocene–Miocene boundary (27–28 m.y.,±5 percent); earlier ages are suggested by interbedding of andesites with known Eocene sediments of North Park. Magmatic activity was related to stages of Laramide tectonism; emplacement of rocks was controlled by orogenic events, and was responsible for the region's complex structure.—*from* Author's abstract

Cosner, L. N. *See* Austin, C. F. 5789

5608 **Cotter, R. D.; Bidwell, L. E.; Oakes, E. L.; Hollenstein, G. H.** Water resources of the Big Stone Lake watershed, west-central Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-213, 4 sheets, scale 1:250,000, 1966.

Sheet 1 includes maps showing areal extent of aquifers and ground-water movement within glacial drift toward the Minnesota River and tributaries, and a block diagram of Cretaceous rock and glacial drift overlying Precambrian bedrock. Sheet 2 includes a map and diagrams related to surface water. Sheet 3 contains a map showing water quality, and tables of chemical analyses of ground and surface water, and water use and municipal supply potential. Sheet 4 has diagrams of the water cycle and summaries of conclusions.—M.C.M.

5687 **Coulter, Henry W.; Migliaccio, Ralph R.** Effects of the earthquake of March 27, 1964 at Valdez, Alaska: U.S. Geol. Survey Prof. Paper 542-C, p. C1–C36, illus., tables, 1966.

Valdez is situated on the seaward edge of a large outwash delta composed of a thick section of saturated silty sand and gravel. The earthquake of March 27, 1964, triggered a massive submarine slide that allowed the shore area to subside and destroyed the harbor facilities and nearshore installations. Waves generated by the slide did additional damage in the downtown area; stresses generated by seismic shock and the slide generated fissures which with the shocks caused structural damage to many buildings and destroyed the sewer and water systems. A geologic evaluation of the relocation site chosen for the town of Valdez is given also. W.L.G.

5540 **Cowgill, Ursula M.; Hutchinson, G. E.** The history of the Petenxil basin, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 121–126, table, 1966.

An attempt is made to reconstruct the history of the lake basin, considering all the data presented in these papers, and determining what relationships may exist between them. The history is divided into three major periods: before 3,000 B.P., a period of slow sedimentation with savanna vegetation and agricultural man already present; from 3,000 to 1,300 B.P., more trees are present, but no tropical forest, cultivation weeds are mixed with the grass, and the plankton population is shifting to Cladocera and there is less organic sediment; and since 1,300 B.P., an environment characterized by a dominant tropical forest. Sedimentation is rapid, perhaps due to uptilt of the southern shore. This history is compared with the Aguada de Santa Ana Vieja.—E.S.L.

5541 **Cowgill, Ursula M.; Hutchinson, G. E.** A general account of the basin and the chemistry and mineralogy of the sediment cores, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 7–62, illus., tables, 1966.

The Laguna de Petenxil is one of a chain of lakes in northern Petén, in a region underlain by Eocene limestones. Sediments from two cores were studied, the oldest having a C-14 age of 3990±160 B.P. The oldest sediments are richest in organic matter. The rate of sedimentation increases upward. Below the upper zone of rapid deposition, sediments are rich in gypsum crystals and pyrite spheres. Inorganic material consists mainly of alumino-silicates, the principal one being halloysite dihydrate. Five events can be recognized by Ca, Sr, and K distribution, and probably represent cultural influences. The distribution of elements is discussed

at some length. The mineralogy was obtained by X-ray diffraction and DTA.—E.S.L.

5713 **Cox, Allan; Dalrymple, G. Brent; Doell, Richard R.** Paleomagnetic locality at Carnelian Bay, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 51–53, illus., 1965.

Two lava flows in this California area of Lake Tahoe are among 28 volcanic units from the Sierra Nevada for which both paleomagnetic polarities and potassium-argon ages have been determined. These results provide part of the basis for the radiometric scale shown for reversals of the Earth's magnetic field. The lower platy-fracturing flow at this outcrop has an age of 2.5 m.y., and a normal polarity; the upper flow, which caps the ridge, has an age of 2.2 m.y., and is of reversed polarity. Weathered volcanic debris and rounded volcanic cobbles occur between the two flows.—G.D.C.

5976 **Creer, Kenneth M.** Continents on the move: Sea Frontiers, v. 12, no. 3, p. 148–157, illus., 1966.

Wegener's continental drift theory and the paleoclimatological and paleomagnetic evidence are reviewed. Polar-wandering curves are drawn for each continent, and when the older similar parts are superimposed, the Paleozoic positions of the continents are reconstructed to indicate two supercontinents. The method of their disintegration is shown by the manner in which the polar-wandering curves branch out. Convection currents are considered as the cause of continental drift.—E.S.L.

6014 **Criner, J. H.** Seismic surveying with firecrackers—A modification of the sledgehammer method, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B104–B107, illus., 1966.

Firecracker explosions proved a successful substitute for blows of a sledgehammer, after the sledgehammer method of seismic surveying failed as a means of determining the depth to bedrock beneath the floor of Trace Creek valley in Humphreys County, Tenn. Further modification of the method by use of a single geophone to record the arrival of shock waves from a linear series of successive explosions resulted in a substantial economy of time and effort.—Author's abstract

Crittenden, Max D., Jr. *See* Baker, Arthur A. 5614

5715 **Croft, M. G.; Wahrhaftig, Clyde.** General geology of the San Joaquin Valley, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 133–137, illus., 1965.

Structurally the San Joaquin Valley is an asymmetric trough with axis close to its western border. Granitic and metamorphic rocks of the Sierra Nevada form its basement, overlain by marine and nonmarine beds of Cretaceous and Cenozoic age. The Cenozoic rocks attain a maximum thickness of 28,000 feet at the south end of the valley; the upper 1,000–5,000 feet are continental. Clay lenses deformed in late Cenozoic time are believed to be lake beds representing periodic changes in climate. The thick continental deposits extending to 2,000 feet below sea level indicate that subsidence of the trough was matched by sedimentation from the mountains, so that after late Pliocene time the valley floor was always above sea level.—G.D.C.

5994 **Cruickshank, James G.; Colhoun, Eric A.** Observations on pingos and other landforms in Schuchertdal, northeast Greenland: Geog. Annaler, v. 47A, no. 4, p. 224–236, illus., 1965.

Schuchertdal in the Scoresby Sound area lies on a major fault between pre Caledonian crystalline rocks and Permian sandstones, conglomerates and limestones. In the northern part the Schuchert Glacier extends for 30 km, and the massive west valley wall, here developed in crystalline rocks, in the south is in vertically jointed limestone capping sandstone; less resistant sedimentary rocks underlie the more

gentle eastern slope of the valley. Frost weathering over permafrost and seasonal fluvial erosion have been the factors in landscape formation during the last glaciation. Pingos, post-dating the marine terrace through which some erupt, are located at the junction of flood plain and valley slope, and are more strongly developed at the base of the eastern slope. On the karst plateau normal features of a humid environment are absent or weakly developed; rock type is the differentiating factor of its landforms.—G.D.C.

6020 **Culbertson, William C.** Trona in the Wilkins Peak Member of the Green River Formation, southwestern Wyoming, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B159-B164, illus., tables, 1966.

About 67 billion tons of trona is contained in 24 beds more than three feet thick in the Wilkins Peak Member of the Eocene Green River Formation. These beds lie at depths of 400 to 3,500 feet in a 1,400 sq mi area in the Green River basin. Another 36 billion tons of mixed trona and halite is contained in 14 beds more than three feet thick in the southern part of this area.—Author's abstract

Cummings, T. Ray. *See* Lowry, Marlin E. 5606

5707 **Curl, Rane L.** Cave conduit enlargement by natural convection: Cave Notes, v. 8, no. 1, p. 2-6, illus., table, 1966.

When limestone goes into solution, the increase in density along the conduit wall can affect circulation so that formation of such features as ceiling pots or tubes is to be expected. There is also a forced flow through a conduit which causes dissolution without a preference as to surface location. The dominant of the two modes depends on a number of variables. An estimate is offered for the relation between these variables which divides the density current from forced convection dissolution.—E.S.L.

5610 **Cushing, E. M.** Map showing altitude of the base of fresh water in coastal plain aquifers of the Mississippi embayment: U.S. Geol. Survey Hydrol. Inv. Atlas HA-221, scale 1:1,000,000, text, 1966.

In the Mississippi embayment, unconsolidated units of Cretaceous age and younger contain fresh water. In southwestern Dallas County, parts of Ouachita County, and south-central Lafayette County, Ark., the base of fresh water is in Cane River Formation sand beds. In southern Arkansas, northwestern Louisiana, and northeastern Texas, other small areas exist where the base of fresh water is at a lower altitude than that shown on the map, generally in lenticular sands of small areal extent.—M.C.M.

5580 **Daetwyler, Calvin Crowell, Jr.** Marine geology of Tomales Bay, central California [abs.]: Dissert. Abs., v. 26, no. 10, p. 5975, 1966.

5550 **Dahlem, David Harrison.** Geology of the Lookout Mountain area, Fremont County, Colorado [abs.]: Dissert. Abs., v. 26, no. 11, p. 6758, 1966.

Dalrymple, G. Brent. *See* Cox, Allan. 5713

6022 **Dalrymple, G. Brent; Doell, Richard R.** Portable core drill and thin-section laboratory for field use, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B182-B185, illus., 1966.

This report describes a portable thin-section laboratory with which two men can make eight to ten thin sections per hour in the field. Tests of the equipment show that it increases the efficiency of sampling for combined paleomagnetic and potassium-argon studies because the suitability of a sample for dating can be determined before any effort has been expended on collecting oriented samples for paleomagnetic study.—Authors' abstract

Danehy, E. A. *See* Skjei, R. E. 5993

5900 **Danø, Marianne.** The crystal structure of tugtupite—A new mineral, $Na_8Al_2Be_2Si_8O_{24}(Cl,S)_2$: Acta Cryst., v. 20, pt. 6, p. 812–816, illus., tables, 1966.

The structure of tugtupite, from Greenland, has been determined by single-crystal X-ray methods. The crystals are tetragonal with space group $I\bar{4}$, and are strongly piezoelectric but show no pyroelectric effect. Optically the mineral is orthorhombic with values of $2V\gamma$ up to 10°. The specific gravity is 2.30±0.02. The unit-cell constants are $a=8.583\pm0.004$, $c=8.817\pm0.004$ Å. Final atomic positions with their Debye temperature factors and bond lengths with their standard deviations are tabulated.—E.S.L.

5872 **Davies, William E.** The earth sciences and speleology: Natl. Speleol. Soc. Bull., v. 28, no. 1, p. 1–14, tables, 1966.

In looking back on a century of history of the earth sciences in speleology, a great variation in progress is noticeable. High points include two decades from 1890 to 1910 when most of the basic concepts of karst hydrology were established; the 12-year period, 1930–1942, which saw the crystallization of most of the theories concerning the origin of caves; and the post-war decade, which in America was an era of regional studies. Today another boom appears to be building up, based on quantitative hydrologic studies of limestone terrain.—*from* Author's conclusions

5860 **Davis, Elwin N.** (editor). Developments in applied spectroscopy, V. 4—Annual Mid-America Spectroscopy Symposium, 15th, Chicago, Ill., 1964, Proc.: New York, Plenum Press, 546 p., illus., tables, 1965.

The present volume contains 45 of the 110 papers presented at this symposium, covering various applications of X-ray spectroscopy, infrared and Raman spectroscopy, ultraviolet and visible spectroscopy, gas chromatography, NMR spectroscopy, and emission, flame, and atomic absorption spectroscopy. Of these papers by Baird, McIntyre, and Welday; Weiblen; and Schrenk and Ho are cited separately.—G.D.C.

Davis, Fenelon P. *See* O'Brien, J. C. 5847

5779 **Davis, Margaret B.** Determination of absolute pollen frequency: Ecology, v. 47, no. 2, p. 310–311, 1966.

Changes in technique have simplified and made more reliable a method for determining the absolute numbers of pollen grains in sediment samples. The prepared sample is suspended in its entirety in the volume of fluid from which measured portions are taken for counting; tertiary butyl alcohol, instead of benzene with dissolved silicone fluid, is used as the suspending fluid.—Author's abstract

Davis, R. W. *See* MacCary, L. M. 5607

Day, D. P. *See* Dobell, J. P. 5761

5673 **Day, Paul R.** Particle fractionation and particle-size analysis, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 545–567, illus., tables, 1965.

A method for separation of clay, silt, and sand fractions of soils using a siphon is described. In discussing procedures in the pipette method of size analysis, sampling and pretreatment, filtration, dispersion and wet-sieving, dry-sieve analysis, sedimentation analysis, and calculation of results are covered. Comments are made on destruction of organic matter, dispersion, classifying and naming fractions, and graphical representation. The hydrometer method is also described, with comments on sampling schedule, soil density, and dispersion.—E.S.L.

Dean, W. C. *See* Archambeau, C. V. 5651

5746 **Deans, T.; Snelling, N. J.; Rapson, J. E.** Strontium isotopes and trace elements in carbonatites and limestones from Ice River, British Columbia: Nature, v. 210, no. 5033, p. 290–291, table, 1966.

The Sr–87/Sr–86 ratio of the carbonatites of the Ice River alkaline complex is found to be significantly different from that of the Ottertail limestones, whether metamorphosed or not, and it is demonstrated that metamorphism has not altered this ratio. The trace-element data clearly reveal that the carbonatites are characterized by the presence of Nb and La, elements not detected in the limestones and marbles, and by a markedly greater abundance of Sr and Ba. These results are completely in keeping with experience elsewhere.—D.B.V.

Deike, R. G. *See* Randolph, J. R. 5685

5815 **Deju, Raul A.; Bhappu, Roshan B.** Surface properties of silicate minerals: New Mexico Bur. Mines and Mineral Resources Circ. 82, 6 p., illus., tables, 1965.

Compositions and structures determined for the most important naturally occurring silicate minerals are tabulated. With an increasing oxygen–silicate ratio, there is increasing oxygen–to–metal bonding. Upon the fracturing of a silicate crystal the ionic oxygen–metal bond should break more easily than the stronger oxygen–silicon bond. The resulting negative forces on the surface should, upon immersion of the mineral in a liquid containing hydrogen ions, be neutralized by the adsorbed hydrogen ions, changing the pH of the solution. Physical adsorption appears to play a minor role. The degree of reaction seems to depend directly on the oxygen–silicon ratio of the silicate structure, being greatest for olivines. The reaction seems to depend on number of exchange sites available on the surface, and to be influenced also by the amount of iron present in the solid.—G.D.C.

Denson, Norman M. *See* White, Walter S. 5634

dePadovani, I. Oliver. *See* Miro, M. 5722

5767 **DePuy, G. W.** Petrographic investigations of rock durability and comparisons of various test procedures: Eng. Geology, v. 2, no. 2, p. 31–40, tables, 1965.

Twenty rock samples were examined and tested in the laboratory to determine their quality for use as riprap. The samples were petrographically examined and run through hardness, strength, freeze–thaw, and routine physical properties tests. Sonic velocity measurements were made and the new ultrasonic cavitation test was applied. The latter shows promise as a good test for rock durability. Rock of very good, and very poor quality generally show consistent results on all tests, but poor to fair quality rock is not as easily evaluated.—E.S.L.

6018 **Deuser, W. G.** Observations on the Fe–Si–Mg relationship in chondrites—A discussion [of paper by L. H. Ahrens, 1965]: Geochim. et Cosmochim. Acta, v. 30, no. 4, p. 455, illus., 1966.

Attention is drawn to an error in Ahrens (ibid., v. 29, no. 7, p. 801–806) article of the above title, and a revised triangular diagram is presented. On the basis of present evidence there is no indication of Mg enrichment of the olivine–bronzite chondrites; the most remarkable thing is, in fact, the constancy of the Si/Mg ratio in both groups of common chondrites.—D.B.V.

5618 **Dibblee, T. W., Jr.** Geologic map of the Lavic quadrangle, San Bernardino County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I–472, scale 1:62,500, sections, separate text, 1966.

The text describes the Cenozoic sedimentary and volcanic rocks, and Mesozoic plutonic and hypabyssal igneous rocks of the Lavic quadrangle. Mines, prospects, and quarries are listed for gold, silver, lead, copper, iron, magnetite(?), clay (bentonite), pumice, agate and jasper.—M.C.M.

6011 **Dietz, R. S.** Earth's original crust—Lost quest?: Tectonophysics, v. 2, no. 6, p. 515–520, illus., 1965.

The cold accretion model for the Earth combined with the secondary origin of sial by mantle differentiation provides a new definition for the term *original crust*—its composition would be ultramafic and chondritic. Owing to the process of mantle thermal convection and of associated differentiation, it might be supposed that this crust would have been completely destroyed. However, by the author's version of the geosynclinal mountain-building cycle, it is likely that fragments of primitive crust were trapped in the oldest eugeosynclines and preserved to modern times. I suggest that eugeosynclines are deposited on sima and, upon their tectonic collapse, trap portions of underlying ultramafic crust in the solid state. Among ultramafic pods in old nuclei of continents, undifferentiated fragments of original crust may still be found. This may be termed a "raisin bread" concept for searching out the Earth's original crust.—*from* Author's abstract

5571 **Dijkerman, Joost Christiaan.** Properties and genesis of textural subsoil lamellae [abs.]: Dissert. Abs., v. 26, no. 10, p. 5641, 1966.

5868 **Dill, Robert F.; Moore, David G.** A diver-held vane-shear apparatus: Marine Geology, v. 3, no. 5, p. 323–327, illus., 1965.

A relatively simple diver-held vane-shear apparatus for measuring surficial shear strength of sea-floor sediments is described. The apparatus consists of a torque screwdriver which has a calibrated scale for reading torque values directly and which was modified by adding a small vane to the shaft. The vane is inserted into a sediment and a direct reading is made of the resistance against the vane at the end of the shaft as the handle is rotated. This value is then converted to shear strength. It can also be used to obtain values of "residual strength" by continuing to twist the dial after the initial shear of the sediment is obtained. The instrument has been used on shipboard to measure relatively undisturbed samples from the deep-sea floor in the new box samplers.—V.S.N.

5990 **Dinwiddie, G. A.; Mourant, W. A.; Basler, J. A.** Municipal water supplies and uses, northwestern New Mexico: New Mexico State Engineer Tech. Rept. 29C, 197 p., illus., tables, 1966.

The most commonly used aquifers in northwestern New Mexico are beds of Pennsylvanian limestone; Permian limestone and sandstone; Triassic Jurassic, Cretaceous, and Tertiary sandstone; and Tertiary and Quaternary deposits of sand and gravel. Both ground and surface water are used for municipal water supplies in the communities (population > 100) under investigation, but only ground water is used extensively because potable surface water is not generally available; water supplies are generally acceptable for domestic use, but locally may contain one or more chemical constituents greater than acceptable limits. Most communities have adequate water supplies, storage and distribution systems, and sewage-disposal facilities; some inadequate facilities will be improved; a few small communities have only private wells and maintain no public water-distribution or sewage-disposal facilities.—*from* Authors' abstract

5761 **Dobell, J. P.; Day, D. P.** Preparation of thin-sections of unconsolidated or friable sediments: Jour. Sed. Petrology, v. 36, no. 1, p. 254, 1966.

Thin sections of friable sediments or of heavy mineral grains are easily made with a thermo-setting resin that has extremely low viscosity at initial temperatures.—H.A.T.

Dodds, J. *See* Bradner, H. 5653

5649 **Doe, B. R.; Hedge, C. E.; White, D. E.** Preliminary investigation of the source of lead and strontium in deep geothermal brines underlying the Salton Sea geothermal area: Econ. Geology, v. 61, no. 3, p. 462–483, illus., tables, 1966.

Lead and strontium isotope ratios in metal-rich geothermal brines are compared to those of rhyolite glass from nearby rhyolite domes and also to those from Tertiary and Quaternary sediments of the area. "The isotopic data indicate that 80–100 percent of the strontium and 50–100 percent of the lead in these brines were acquired from the associated sediments" rather than from the rhyolite. The ratios for

strontium suggest that the rhyolite cannot be derived wholly from melting of sediments like those sampled.—W.S.W.

Doell, Richard R. *See* Cox, Allan. 5713

Doell, Richard R. *See* Dalrymple, G. Brent. 6022

Donnelly, Thomas W. *See* Rogers, John J. W. 5948

6010 **Dosso, H. W.** Analogue model measurements for electromagnetic variations near vertical faults and dykes: Canadian Jour. Earth Sci., v. 3, no. 3, p. 287–303, illus., 1966.

An analogue model for studying the behavior of the natural geomagnetic and telluric field variations for various geological structures is described. Measurements of amplitudes and phases for the horizontal electric, the horizontal magnetic, and vertical magnetic field components are obtained and discussed for various conducting vertical faults and dykes for both the *H* and *E* polarizations.—Author's abstract

5986 **Douglas, Robert; Sliter, William V.** Regional distribution of some Cretaceous Rotaliporidae and Globotruncanidae (Foraminiferida) within North America: Tulane Studies Geology, v. 4, no. 3, p. 89–131, illus., tables, 1966.

A comparison of Late Cretaceous planktonic Foraminifera from the Pacific Coast with those of the Atlantic Coast and Gulf–Caribbean regions provides new information on the stratigraphic and paleogeographic distribution of *Praeglobotruncana, Hedbergella, Globotruncana, and Rugoglobigerina.* They were neither universally nor ubiquitously distributed. Genera ranged widely during the Turonian to early Maestrichtian, but some species were restricted geographically. Planktonic Foraminifera provide an excellent basis for stratigraphic correlations between the Pacific Coast and Gulf–Caribbean region for strata of Cenomanian–Turonian and Campanian early Maestrichtian age. Thirty-two species from California are systematically described and illustrated.—*from* Authors' abstract

5764 **Douglass, Raymond C.** Restudy of *Triticites secalicus* (Say), the type species of *Triticites*: Micropaleontology, v. 12, no. 1, p. 71–78, illus., tables, 1966.

Triticites secalicus (Say), the type species of the genus *Triticites* Girty, is described fully from the type area, and data are presented which can be used for more valid comparisons with other species than has hitherto been possible.—Author's abstract

5966 **Dreimanis, A.; Terasmae, J.; McKenzie, G. D.** The Port Talbot interstade of the Wisconsin glaciation [with French abs.]: Canadian Jour. Earth Sci., v. 3, no. 3, p. 305–325, illus., tables, 1966.

The Port Talbot interstade is the interval separating early and late Wisconsin in the Lake Erie region. Lithologic and palynologic investigations of cores from the type area, and new C–14 dates, suggest that this interval was considerably longer than previously assumed, lasting from 48,000 to 24,000 yr B. P. The entire nonglacial interval comprises two relatively warm episodes, separated by a brief glacial readvance during which 100 varves were deposited. Pine and spruce pollen predominate throughout the section, with a relative abundance of oak in the Port Talbot I green clay. The assemblages are unlike those of the Sangamon interglacial or postglacial in southern Ontario.—E.S.L.

5991 **Dumbleton, M. J.; West, G.; Newill, D.** The mode of formation, mineralogy and properties of some Jamaican soils: Eng. Geology—Internat. Jour., v. 1, no. 3, p. 235–249, illus., tables, 1966.

The mineralogy of samples of a number of soil types from Jamaica was compared with their geological origin and condition of formation, and with their properties as roadmaking materials. Well-drained bauxite soils formed on calcic limestone are progressively leached of kaolinite until only iron and aluminum oxides remain. Associated with these changes is a decrease in clay content and in plasticity; the

engineering properties of the soils are influenced by the cementing effect of hematite. Soil formed on poorly-drained shale has a high montmorillonite content and poor compaction characteristics. Alluvial soils from low areas contain kaolinite, montmorillonite, and vermiculite or illite, have high clay contents, and are very plastic.—G.D.C.

5780 **Dunlap, John C.; Overstreet, Elizabeth F.** Bauxite deposits, Summerville area, Georgia, *in* Bauxite deposits of northwest Georgia: U.S. Geol. Survey Bull. 1199-M, p. M33-M41, illus., 1966.

All known bauxite deposits in the Summerville area, within the Valley and Ridge province of the Appalachian Mountains, are within the Chattooga River drainage basin, occurring on slopes at altitudes ranging from 725-900 feet above sea level. Bauxite is generally pisolitic, some red, some white; all deposits occur as pods in areas underlain by sedimentary rocks of the Cambrian-Ordovician Knox Group and are associated with residual clay derived from dolomitic strata of that group. Four of the five deposits are close to major thrust faults; the fifth is close to the contact between the Knox Group and older Cambrian rocks. Deposits are located on a sketch map and described.—M.C.M.

5798 **Eastwood, Raymond L.; Brookins, Douglas G.** A spectrochemical investigation of the Bala and Stockdale intrusions, Riley County, Kansas: Kansas Acad. Sci. Trans., v. 68, no. 1, p. 72-87, tables, 1965.

Chromite, two varieties of garnet, chloritized phlogopite, magnetite, and serpentinized olivine from the Bala and Stockdale intrusions were analyzed for Co, Cu, Cr, Ni, Ti, and Zr because of the significance of these elements in basic rocks. The TiO_2 content of the magnetites indicates a temperature of injection of 400°C to 550°C and copper depletion indicates that solution has occurred in the Stockdale intrusion. From the observed sequence of crystallization it appears that the two intrusions were differentiated from a common parent magma. Essentially closed system conditions prevailed during injection.—E.S.L.

Eaton, G. P. *See* Mudge, M. R. 5998

5539 **Echols, Dorothy J.; Levin, Harold L.** Ordovician Chitinozoa from Missouri: Oklahoma Geology Notes, v. 26, no. 5, p. 134-139, illus., 1966.

Chitinozoans are becoming increasingly valuable as a micropaleontologic tool in stratigraphic analysis. The present study involves microscopic organic remains recovered from samples of Ordovician Mohawkian and Cincinnatian rocks in Cape Girardeau County from five core holes drilled into the Plattin Limestone, and from two northeastern outcrops exposing the Plattin Limestone, Decorah Shale, Kimmswick Limestone, and Maquoketa Shale. The Plattin outcrop samples contained excellent chitinozoans, and the basal Kimmswick a similar assemblage; of the eight Plattin core samples only three contained excellent chitinozoans. Two plates illustrate the stratigraphic positions of the forms recovered. Recorded occurrences of these problematic forms from marine sediments of other areas of the world indicate a free-floating mode of life which make them potential index fossils.—G.D.C.

5729 **Edmondson, William F.** The Meganos Gorge of the southern Sacramento Valley: San Joaquin Geol. Soc. Selected Papers, v. 3, p. 36-51, illus., 1965.

The Meganos Gorge, a large fossil channel of late Paleocene age, 44 mi long and covering an area of about 200 sq mi, is filled by Division C of the Meganos Formation, here named Meganos Gorge Fill. Maximum thickness of the dominantly marine shale fill is about 2,500 feet, and is of major importance because it traps oil and gas both in pre-gorge sediments and in sand present in the fill at the eastern end of the gorge. Relation of the gorge to the Midland fault and the Cretaceous-Tertiary boundary is discussed. Correlation sections and sketch maps are included.—E.S.L.

5817 **Edmonton Geological Society; Knipping, H. D.; Rudy, H. R.; Smith, J. Y.** (compilers). David Thompson Highway from Windy Point to the junction with

the Banff–Jasper Highway—Road log, 7th annual field trip, 1965: Edmonton, Alberta, Edmonton Geol. Soc., 15 p., illus., geol. map, 1965.

This trip closely follows the North Saskatchewan River as it cuts through the Front and Main Ranges of the Canadian Rocky Mountains. The accompanying geological map is a composite of Douglas' Nordegg map, information from other mapping projects, and sketches. Two stratigraphic cross-sections by J. D. Aitken correlate pre-Devonian mountain sections with some wells in the plains of Alberta. The nomenclature is that used by the Geological Survey of Canada.—G.D.C.

5625 **Emery, K. O.** Early man may have roamed the Atlantic shelf: Oceanus, v. 12, no. 2, p. 3–5, illus., 1966.

Projectile points associated with mammoth and mastodon bones and teeth found on the Atlantic Coastal Plain have been carbon dated between 12,000 and 10,000 yr. old. On the continental shelf, shells of the edible shallow-water oyster 7,200 to 10,850 yr old, and two others 17,300 and 21,000 yr old, have recently been dredged from a band of post-glacial sediments at depths up to 90 m. Intertidal peat at depths as much as 59 m indicate that 11,000 yr ago sea level was that much lower than at present. Marine scientists and fishermen should keep a close look-out for masses of shell middens, broken tools and bones of this age in these depths at sea, as evidence of early man.—G.D.C.

5866 **Emery, K. O.; Uchupi, Elazar.** Structure of Georges Bank: Marine Geology, v. 3, no. 5, p. 349–358, illus., 1965.

About 1,600 km of continuous seismic (sparker) profiles were recorded in the area of Georges Bank during 1963 and 1964. Structural cross sections and a structural contour map were drawn from the recordings. These materials, supplemented by soundings and bottom samples, indicate that the bank is underlain by Cretaceous, Tertiary, and Pleistocene strata that dip gently seaward and steepen near the continental slope. Unconformities are present between each of these main stratigraphic sequences. The bank is clearly a northeasterly extension of the continental shelf that borders southern New England. It has the form of a cuesta that is bounded on its landward side by the Gulf of Maine, which was deeply eroded by glaciers and possibly by preglacial streams.—Authors' abstract

5919 **Emery, K. O.** Geology of the continental margin off eastern United States, *in* Submarine geology and geophysics—Colston Research Society Symposium, 17th, Bristol, England, 1965, Proc.: London, Butterworths, p. 1–17, illus., 1965.

The lithology and structure of the region indicate the presence of Paleozoic intrusive igneous and sedimentary rocks, and of Mesozoic sedimentary strata deeply underlying most of the continental shelf. Throughout most of the continental shelf and on Blake Plateau these rocks are overlain by Plio-Miocene strata. The suggestion is advanced that the continental slope and associated lesser slopes were formed by faulting during early Tertiary and were modified by submarine erosion. Sediments of later Tertiary took the form of prograded beds on the continental side of the slope and of flysch-type beds on the oceanic side. Topography and sediments of the surface of the continental shelf indicate both erosion and deposition during Pleistocene glacial stages of lowered sea-level. Post-glacial sedimentation has been unable to modify the surface except locally.—*from* Author's abstract

5609 **Emery, Philip A.** Geohydrology of Saline County, Nebraska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-216, scale 1:125,000, separate text, 1966.

In Saline County, only deposits of Quaternary age are known to contain large supplies of potable ground water, although small supplies are obtained from Lower Cretaceous Dakota Sandstone and Upper Cretaceous Greenhorn Limestone. Quaternary deposits are principally unconsolidated gravel, sand, silt, clay, and till, 0 to more than 400 feet in thickness. In about half the county large-capacity wells cannot be developed, or water is too saline for most uses. The map sheet includes a fence diagram, and maps showing geology, configuration of bedrock surface and water table, transmissibility of Quaternary deposits, and chemical quality of ground and surface water.—M.C.M.

5911 **Engelund, Frank.** Hydraulic resistance of alluvial streams: Am. Soc. Civil Engineers Proc., v. 92, paper 4739, Jour. Hydraulics Div., no. HY2, p. 315–326, illus., 1966.

From a theoretical point of view it may be assumed that under quasi-steady conditions alluvial rivers will adopt some definite bed configuration that has a dominating influence on the magnitude of the hydraulic resistance. Results presented in this paper show that the rules governing the hydraulic resistance of alluvial rivers may be deduced by assuming the general similarity of the dune formations.—G.D.C.

Enticknap, R. G. *See* Wood, R. V., Jr. 5680

6001 **Epstein, Jack B.** Structural control of wind gaps and water gaps and of stream capture in the Stroudsburg area, Pennsylvania and New Jersey, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B80–B86, illus., 1966.

Wind gaps and water gaps in the Stroudsburg area, in eastern Pennsylvania and northern New Jersey, are located where resistant rocks dip steeply and have a narrow width of outcrop, where folds die out over short distances, or where folding was more intense locally than nearby. All gaps trend about perpendicular to the strike of the ridges, and parallel to major cross-joint sets. These observations favor the hypothesis of structural control of the location of stream gaps, rather than that of regional superposition of the streams upon the resistant rocks. A second type of structural control, in which more resistant beds were exposed in Wind Gap than in Delaware Water Gap, may explain the capture of Wind Gap River by tributaries of the Delaware River.—Author's abstract

5617 **Erickson, Ralph L.** Geologic map of part of the Friendship quadrangle, Lewis and Greenup Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-526, scale 1:24,000, section, text, 1966.

Resources of the Friendship quadrangle are limited to refractory clay from the Olive Hill Clay Bed and dimension stone from the lower part of the Borden Formation.—M.C.M.

5971 **Essene, E. J.; Fyfe, W. S.; Turner, F. J.** Petrogenesis of Franciscan glaucophane schists and associated metamorphic rocks, California: Beitr. Mineralogie u. Petrographie, v. 11, no. 7, p. 695–704, illus., 1965.

In the Franciscan Formation of California the most widely distributed metamorphic rock is jadeite-lawsonite metagraywacke veined with aragonite. More spectacular, but mainly in isolated blocks, are coarse-grained glaucophane-lawsonite schists of many kinds, commonly associated with serpentinite, near which are also blocks of amphibolite and eclogite. All of these are considered to have been metamorphosed and metasomatized at depth in a folded geosynclinal prism. Coarse grain is not necessarily a criterion of higher grade. The role of serpentinites in glaucophane-schist metamorphism is considered in a tentatively proposed model dealing with changes in temperature with time and at varying depths, and with the resulting mineral products, marginal rock development, and retrogressive alteration of eclogite and amphibolite to glaucophane-schist assemblages.—G.D.C.

5647 **Etheridge, Richard.** Pleistocene lizards from New Providence: Florida Acad. Sci. Quart. Jour., v. 28, no. 4, p. 349–358, 1965.

A small collection of lizards is described from the Banana Hole, a sinkhole deposit of pre-Pamlico Wisconsin age on New Providence Island, Bahamas. The site also has yielded a large bird fauna (Brodkorb, 1959). The seven species of small lizards probably represent an accumulation of owl pellets. The most abundant are *Anolis carolinensis, A. distichus, and A. sagrei*, all living on the Island today, the latter two recorded as fossils for the first time. *Tarentola americana and Cyclura* sp., now extinct on New Providence, are living in Cuba and on other Bahaman islands, respectively. The New Providence Pleistocene lizard fauna was richer than that of today; faunal ties were then, as now, primarily with Cuba.—V.M.J.

5639 **Evans, David M.** Man-made earthquakes in Denver: Geotimes, v. 10, no. 9, p. 11–18, illus., 1966.

This is essentially the same as the paper published in *Mountain Geologist*, v. 3, no. 1, p. 23–36, 1966.—M.C.M.

5771 **Evans, David M.** The Denver area earthquakes and the Rocky Mountain Arsenal disposal well: Mtn. Geologist, v. 3, no. 1, p. 23–36, illus., table, 1966.

During 1961, a deep well was drilled at the Rocky Mountain Arsenal northeast of Denver, Colo., to dispose of waste water. The well is bottomed in 75 feet of highly fractured Precambrian gneiss. Pressure injection of waste water into the fractured rock was begun in March 1962. Since the start of fluid injection, 710 Denver-area earthquakes have been recorded. The majority of these earthquakes had epicenters within a five-mile radius of the Arsenal well. The volume of fluid and pressure of fluid injection appear to be directly related to the frequency of earthquakes. Evidence also suggests that rock movement is due to the increase of fluid pressure within the fractured reservoir and that open fractures may exist at depths greater than previously considered possible.—Author's abstract

5775 **Evans, Robert.** The structure of the salt deposit at Pugwash, Nova Scotia: Maritime Sediments, v. 1, no. 3, p. 21–23, illus., 1965.

The salt deposit in the Pugwash mine consists of white, gray, and brown banded halite. Anhydrite occurs poikilitically within halite grains, and as a 100-ft layer near the base of the sequence. Brecciated clastic and carnallite layers are interbedded in places. The salt body has been severely deformed and over 50 folds have been identified, including several refolded folds. Axial planes are oriented with the axial plane of a major fold in the overlying Pictou Group. A geologic sketch map is included.—E.S.L.

5834 **Everett, D. E.; Rush, F. Eugene.** A brief appraisal of the water resources of Grass and Carico Lake Valleys, Lander and Eureka Counties, Nevada: Nevada Dept. Conserv. and Nat. Resources, Water Resources—Reconn. Ser. Rept. 37, 27 p., illus., tables, 1966.

The source of practically all ground water in Grass and Carico Lake Valleys is precipitation within the drainage basins. Most ground water is discharged by evaporation from land surface, evapotranspiration by phreatophytes and crops, and subsurface outflow through Rocky Pass. Most occurs in alluvium; about 16,000 acre-feet is in storage in each saturated ft of alluvial deposits in Grass Valley and about 8,000 acre-feet in Carico Lake Valley. Chemical analyses suggest that ground water generally is suitable for agricultural uses. Most favorable areas for development of ground water are south and west of the Grass Valley playa and south of the Carico Lake Valley playa.—*from* Authors' abstract

Fay, C. B. *See* Meyer, W. C. 5781

5588 **Fink, Dwayne Harold.** Some mineralogical and physical interpretations of free-swelling characteristics of montmorillonite-water systems [abs.]: Dissert. Abs., v. 26, no. 10, p. 6085, 1966.

5822 **Firby, James R.** New non-marine Mollusca from the Esmeralda Formation, Nevada: California Acad. Sci. Proc., 4th ser., v. 33, no. 14, p. 453–479, illus., table, 1966.

Two new species of pelecypods, *Sphaerium stewartensis and Pisidium leslieae*, and five new gastropods, *Vorticifex stewartensis, Planorbis webbi, Bulimnea webbi, Goniobasis reticulata, and G. leslieae*, are described from the late Tertiary Esmeralda Formation, Nye and Mineral Counties, Nev. They are part of a nonmarine fauna of 34 taxa, here called the Cedar Mountain molluscan fauna, which is closely related to that of the Truckee Formation of western Nevada. The Cedar Mountain fauna is associated with mammals of late Miocene and early Pliocene age. Character and field relations of the sediments indicate lake-margin or shallow-water environment.—V.M.J.

Fisher, F. S. *See* Ketner, K. B. 5859

5995 **Flagler, Charles W.** Subsurface Cambrian and Ordovician stratigraphy of the Trenton Group–Precambrian interval in New York State: New York State Mus. and Sci. Service Map and Chart Ser., no. 8, 57 p., illus., table, 1966.

Cuttings of 38 key test wells in New York were examined. The Trenton limestones grade eastward into the calcareous shales of the Canajoharie and Dolgeville. The Black River Group is easily recognized by lithographic limestones correlative with Lowville, and highly variable lithologies of the Pamelia. Certain rocks in contact with the basement, previously considered Potsdam, are believed to be correlative with the Black River. The regional unconformity at the base of the Trenton–Black River can be traced throughout the subsurface. Below the unconformity, the Beekmantown is represented by beds correlative with the Chuctamunda Creek Dolomite (previously grouped with the Little Falls), and the Tribes Hill. The Saratoga Springs Group is complete over much of the area; contacts are transitional but can be picked. Facies are present in the Theresa. Two structure maps, two isopach maps, and eight cross sections accompany the report.—E.S.L.

5810 **Flanigen, E. M.; Breck, D. W.; Mumbach, N. R.; Taylor, A. M.** New hydrothermal emerald: Gems and Gemology, v. 11, no. 9, p. 259–264, 286, illus., 1965.

Work at the Research Laboratory of Union Carbide Corporation's Linde Division, Tonawanda, N. Y., led to a process for producing synthetic hydrothermal emeralds of a quality believed comparable to the finest natural gemstones. Crystals as large as 17 carats and faceted stones of three to four carats have been produced. The Linde material described here also has been compared with other synthetic emeralds. It can be identified by its exceptionally high optical quality, color and brilliance, its high refractive index, birefringence and density. Its bright-red fluorescence and color through the Chelsea filter, and differences in crystal inclusions should differentiate it from most natural stones.—G.D.C.

Fleck, P. L. *See* Briscoe, H. W. 5681

5917 **Fletcher, Joel E.; Bender, Gordon L.** (editors). Ecology of groundwater in the southwestern United States—Symposium, Arizona State Univ., 1961: Tempe, Ariz., Am. Assoc. Adv. Sci., Southwest and Rocky Mtn. Div., and Ariz. State Univ. Bur. Publications, 74 p., illus., tables, 1965.

The Committee on Desert and Arid Zones Research, which arranged and conducted this symposium, was established in 1951. The group stresses interdisciplinary approach to problems associated with the occupancy of arid regions; the present symposium is the fifth in the series. Five chapters by separate authors give a perspective of groundwater in the southwest, its natural recharge, analog computing in arid-zone hydrology, geophysical studies, and artificial recharge which, except for the latter, are cited separately.—G.D.C.

Flinn, E. A. *See* Archambeau, C. V. 5651

5679 **Forbes, C. B.; Obenchain, R.; Swain, R. J.** The LASA sensing system design, installation, and operation: IEEE Proc., v. 53, no. 12, p. 1834–1843, illus., 1965.

The design of the LASA sensing system, the establishment of system specifications, and the selection of components are discussed. Installation of seismograph systems included drilling and casing of 504 200-ft and 21 500-ft wells, 3,000,000 feet of cable, and installation and calibration of the seismometers and amplifiers. The sensing circuits were equalized to a system sensitivity of 20 mv per mμ of earth motion or roughly to saturation of a typical amplifier by a signal from a 7.75 event. Maintenance of the system is described.—V.S.N.

Forbes, Robert B. *See* Foster, Helen L. 5940

5721 **Forster, William; Zeidlin, Harry.** A modified dimethylglyoxime method for the determination of nickel in sea water: Anal. Chim. Acta, v. 35, no. 1, p. 42–53, illus., tables, 1966.

The most sensitive and selective colorimetric reagent that has been used to determine nickel in silicate rocks and other materials is DMG. It is sufficiently specific to detect one part of nickel in 400,000 parts of water containing 50 parts of cobalt. This report is concerned with modification and improvement of the DMG method described by Thompson and Laevastu (1956). For a maximum precipitation of 90 percent of the nickel at least seven days were necessary between salinity treatment and filtration. A salt effect resulted from a gain in absorbance due to soluble ions not precipitated by sodium carbonate, which increased with increasing salt concentration, and an offsetting loss in absorbance due to incomplete precipitation of nickel. Consistent recovery yields of 97 percent were obtained from samples of sea water spiked with nickel collected over a period of several months.—G.D.C.

5940 **Foster, Helen L.; Forbes, Robert B.; Ragan, Donal M.** Granulite and peridotite inclusions from Prindle Volcano, Yukon-Tanana Upland, Alaska, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B115-B119, illus., table, 1966.

Lava of Prindle Volcano, an isolated alkali-olivine basalt cone in the Tanacross C-2 quadrangle, Yukon-Tanana Upland, Alaska, contains abundant peridotite and granulite inclusions. Prindle Volcano reinforces the evidence for the existence of a belt of eruptive centers of similar peridotite-bearing alkali-olivine basalt along the western margin of North America from Mexico to Alaska.—Authors' abstract

Foulks, R. *See* Bradner, H. 5653

5581 **Frantz, Wendelin Robert.** A subsurface stratigraphic study from the top Wilcox to the top Vicksburg in central Louisiana [abs.]: Dissert. Abs., v. 26, no. 10, p. 5975-5976, 1966.

5621 **Frederickson, E. A.; Redman, R. H.** Geology and petroleum of Love County—Pt. 1, Geology of Love County: Oklahoma Geol. Survey Circ. 63, p. 5, 7-47, 78-87, illus., geol. map, 1965.

This county is almost wholly within the Gulf Coastal Plain and is underlain by gently dipping sedimentary rocks of Cretaceous age except in the northwest corner where horizontal Permian sandstones occur. In eroded parts of the northwestern area steeply folded and faulted strata of Pennsylvanian age are exposed in an extension of the Ardmore basin. The dominant structure in Cretaceous rocks is the Marietta syncline, on the southwestern limb of which a 5- to 6-ft-thick biostrome is interpreted as tongue of the Walnut Formation within the Antlers Sandstone. Five Pleistocene terraces are well developed along the Red River. A geologic map is in a pocket, and measured sections are in an appendix.—G.D.C.

5984 **French, Bevan M.** Some geological implications of equilibrium between graphite and a C-H-O gas phase at high temperatures and pressures: Rev. Geophysics, v. 4, no. 2, p. 223-253, illus., 1966.

The study of equilibrium between graphite and a coexisting gas phase is significant because of the occurrence of graphite as an accessory mineral in meteorites and metamorphic and igneous rocks. Values of $P_{carbon\ dioxide}$, $P_{carbon\ monoxide}$, P_{water}, $P_{hydrogen}$, and $P_{methane}$ have been calculated by a computer for a wide range of geologically possible conditions. These show that methane may be a significant to dominant constituent of the gas phase in many reducing environments, original graphite will stabilize increasingly reduced mineral assemblages during metamorphism, observed differences in P_{oxygen} in metamorphic rocks over short distances may be conditioned by the presence or absence of graphite, and it is possible that the atmosphere could have evolved by conversion of original methane to water and CO_2 by reaction with graphite within the Earth.—E.S.L.

Frink, John W. *See* Okeson, Clifford J. 5766

5958 **Frondel, Clifford; Ito, Jun.** Composition of rhodizite [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., ser. 3, v. 10, nos. 1-4, p. 409-412, tables, 1965.

A chemical analysis of rhodizite from Madagascar establishes the new formula $CsAl_4Be_4B_{11}(OH)_4O_{25}$, space group $P\bar{4}3m$; a_o 7.317±0.001A; density 3.44±0.01 (meas.), 3.47 (calc.); Z=1. The index of refraction, 1.693±0.001 (Na), and the unit cell dimension, are identical to other material from lithia-pegmatites in Madagascar.—*from* Authors' abstract

Frosch, R. A. *See* Green, P. E., Jr. 5678

Fyfe, W. S. *See* Essene, E. J. 5971

Gait, R. I. *See* Barry, G. S. 5827

5728 **Gallear, Darrell C.; Kistler, James O.** The 29D Monarch and 10-10 pool—A "sleeper" in the old Midway-Sunset oil field, Kern County, California: San Joaquin Geol. Soc. Selected Papers, v. 3, p. 19-35, illus., 1965.

This pool, although surrounded by wells in an old producing area, remained undiscovered until December 1962. Closure is not present in the uppermost Miocene horizons on the 29D part of the Spellacy anticline, but westward thickening of deeper sediments provides local closure in the Monarch and 10-10 sands. Among the significant phenomena noted in the pool discovery were the fact that 10 feet or less of shale formed a vertical barrier, and that tilted oil-water interfaces were found in all reservoirs. Cumulative production through June 1965 exceeded 4,000,000 bbl, and peak production was nearly 9,000 bbl per day. Isopach and structure maps, and sections are included.—E.S.L.

5669 **Gardner, Walter H.** Water content, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 82-127, illus., 1965.

Direct methods for determining the water content of soils are those wherein water is removed by evaporation, leaching, or chemical reaction, and the amount removed determined. Examples described are gravimetry with oven drying, and drying by burning alcohol. Indirect methods involve measurement of some property of the soil affected by water content, or of some property of an object placed in the soil which comes to water equilibrium with it. Examples described are electrical conductivity and capacitance, neutron thermalization, and gamma ray or neutron attenuation.—E.S.L.

5706 **Garrison, John R.** New Jersey's water resources: [Trenton, N. J.] New Jersey Div. State and Regional Planning, 40 p., illus., [1966?].

The five ground water provinces of New Jersey and their yields are: (1) Appalachian Valley, great range in yield; (2) Highlands, yields of 20-50 gpm; (3) Piedmont Plain, 100-150 gpm; (4) Inner Coastal Plain, 200-500 gpm; and (5) Outer Coastal Plain, to 500 gpm. The latter could supply water to ease the northeastern problem, if the necessity arose. Both Coastal Plain provinces are threatened by encroachment of salt or polluted water. For long-range planning, the trend appears to be toward utilization of surface water for North Jersey and ground water for South Jersey.—M.C.M.

5566 **Gates, Gary Rickey.** Mineral resource inventories for use in economic development planning [abs.]: Dissert. Abs., v. 26, no. 11, p. 6643-6644, 1966.

5841 **Geldart, L. P.; Gill, Denis E.; Sharma, Bijon.** Gravity anomalies of two dimensional faults: Geophysics, v. 31, no. 2, p. 372-397, illus., 1966.

A simplified formula for the gravity effect of a horizontal semi-infinite block truncated by a dipping plane is used to obtain gravity anomaly curves for blocks of different thicknesses and depths truncated by planes dipping at various angles. Results are obtained for faulted horizontal beds for a wide range of bed thicknesses and depths, fault displacements and dips. The asymmetry of the fault curves is related mainly to the fault dip, and can be used to determine dips between 30° and 90°. If the fault dip, density contrast and bed thickness are known, depths

to the bed on the two sides of the fault are given by the sizes and positions of the gravity maximum and minimum.—D.B.V.

5949 **George, J. R.; Wark, J. W.** Single-bottle sampling in operation of a sediment station, *in* Selected techniques in water resources investigations, 1965: U.S. Geol. Survey Water-Supply Paper 1822, p. 89–93, illus., table, 1966.

An analysis of sediment-sample data for the Delaware River at Trenton, N. J., indicates that single-bottle sampling provides results that compare favorably with suspended-sediment concentrations determined from multiple-bottle samples. Where sediment concentration of a stream changes slowly with respect to time and concentration generally is well distributed with respect to stream depth, these data suggest that adequate definition of suspended-sediment concentration can be obtained with single-bottle samples.—Authors' abstract

5969 **Gile, L. H.; Peterson, F. F.; Grossman, R. B.** Morphological and genetic sequences of carbonate accumulations in desert soils: Soil Sci., v. 101, no. 5, p. 347–360, illus., 1966.

Authigenic carbonate horizons of many desert soils of southern New Mexico have formed in thick well-drained alluvium. Carbonate horizons formed in gravelly sediments display a different morphological sequence with continued accumulation of carbonate as compared with horizons formed in nongravelly sediments. In latest stages, the sequences converge on a common overall morphology in which a laminar horizon overlies a carbonate-plugged K-horizon. The sequence on gravelly sediments can be completed on late Pleistocene age surfaces. In many soils on older surfaces the carbonate horizon morphology suggests more than one major cycle of carbonate accumulation.—J.W.H.

Gill, Denis E. *See* Geldart, L. P. 5841

5932 **Gill, James R.; Cobban, William A.** Regional unconformity in Late Cretaceous, Wyoming, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B20–B27, illus., 1966.

An important unconformity, present throughout much of Wyoming at the base of the Teapot Sandstone Member of the Mesaverde Formation and its lateral equivalents—the Pine Ridge Sandstone Member of the Mesaverde Formation and the upper part of the Ericson Sandstone, is the result of erosion that took place about 72 m.y. ago following broad regional uplift. The Teapot equivalents rest on progressively older rocks from east to west. Possibly as much as 3,600 feet of strata was eroded from the western part of the State.—Authors' abstract

5567 **Glaser, Gerald Clement.** Lithostratigraphy and carbonate petrology of the Viola Group (Ordovician), Arbuckle Mountains, south-central Oklahoma [abs.]: Dissert. Abs., v. 26, no. 11, p. 6644, 1966.

5823 **Gleeson, C. F.** Lead content of stream and spring sediments, Keno Hill area, Yukon Territory: Canada Geol. Survey Prelim. Ser. Map 45-1965, scale 1:126,720, text, 1966.

The Keno Hill map-area is underlain by a series of metamorphosed sedimentary rocks, which appear to range from Precambrian to Mesozoic in age. Mafic igneous sills and lenses now altered to greenstones are interlayered with the metamorphosed sediments. Most lead-silver ore deposits occur along northeasterly-striking vein faults in thick-bedded quartzite and occasionally in greenstone. The area has undergone several stages of glaciation; permafrost is present everywhere. Most creeks draining known mineral deposits give anomalous values of lead in stream sediments. Further detailed investigations are warranted in several areas.—M.C.M.

5739 **Glover, R. E.** Ground-water movement: U.S. Bur. Reclamation Eng. Mon. 31 (revised), 76 p., illus., tables, 1966; originally published 1964.

Problems encountered in planning and development of Bureau of Reclamation water resources projects in western United States include analysis of depletions caused

by pumping, estimates of seepages, computation of return flows, analysis of drawdown, and estimates of permeabilities for selection of pump capacities. In the analysis of these and other ground-water problems, theoretical assumptions and limitations are outlined and specific problems computed through use of charts, tables, and solution of equations derived from the theoretical considerations. Cases presented represent transient conditions; in general, steady states are considered only where they represent a terminal condition.—*from* Author's introduction

Goldman, H. B. *See* O'Brien, J. C. 5847

5694 **Goldsmith, Richard.** Stratigraphic names in the New London area, Connecticut: U.S. Geol. Survey Bull. 1224-J, p. J1-J9, illus., table, 1966.

Detailed geologic mapping since 1955 in southeastern Connecticut has made necessary revision and redefinition of older stratigraphic units. The geologic section consists of sedimentary and volcanic rocks of middle and early Paleozoic to possibly Precambrian age metamorphosed to gneiss, quartzite, and schist of sillimanite grade. Intrusive granite and quartz monzonite are interspersed throughout the section. The stratigraphic column seems to be in accord with current interpretations of the stratigraphy in other areas of southeastern Connecticut and with the general stratigraphic column in eastern Massachusetts. Units described, from youngest to oldest, are Brimfield Schist, Monson Gneiss, New London Gneiss and Joshua Rock Gneiss Member, Mamacoke Formation, and Plainfield Formation. Also described are granitic rocks of the Sterling Plutonic Group of pre-Pennsylvanian age. Author's abstract

5576 **Gomah, Aly Hemedah.** Gelatin models for photoelastic study of slope stability in open-pit mines [abs.]: Dissert. Abs., v. 26, no. 10, p. 5964, 1966.

5811 **Goodman, R. E.; Seed, H. Bolton.** Earthquake-induced displacements in sand embankments: Am. Soc. Civil Engineers Proc., v. 92, paper 4736, Jour. Soil Mechanics and Found. Div., no. SM2, p. 125-146, illus., tables, 1966.

When the soil is dry or partially saturated, failure of banks usually results from the sliding of a mass near the surface. Experiments were conducted to investigate the relationships between slope accelerations and displacements in a bank of cohesionless material subjected to ground motion. A procedure is described for computing the magnitude of displacements for different slopes and for a sequence of acceleration pulses. Tests have been made in which the induced acceleration increased by approximately 100 percent from base to top of slope; accelerations developed at midslope height might reasonably well be used for analysis. With information on the magnitude of downslope displacements, the amount of crest settlement of embankments by earthquake motions can be estimated.—G.D.C.

Goodman, Richard E. *See* Seed, H. Bolton. 5839

6025 **Gordon, Mackenzie, Jr.** Permian coleoid cephalopods from the Phosphoria Formation in Idaho and Montana, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B28-B35, illus., tables, 1966.

Belemnite-like coleoid cephalopods belonging to the family Aulacoceratidae occur in two phosphate shale members of the Phosphoria Formation. The Meade Peak Member of Early Permian age contains *Stenoconites idahoensis* n. gen., n. sp., at four localities in southeastern Idaho. This is the oldest Permian coleoid known. The Retort Member of Late Permian age contains *"Dictyoconites"* cf. *"D." groenlandicus* Fischer at six localities in southwestern Montana. *"D." groenlandicus* was originally described from northeastern Greenland. Both genera appear to be closely related to, but not identical with, true *Dictyoconites* of the Alpine Triassic. A fairly direct seaway connecting Greenland and southwestern Montana is implied by the distribution of *"Dictyoconites."*.—Author's abstract

Goulden, C. E. *See* Hutchinson, G. E. 5558

5684 **Goulden, Clyde E.** The animal microfossils, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 84–120, illus., tables, 1966.

Samples were taken at 5 cm intervals from two cores of the lake sediments, and microfossils were quantitatively determined. The remains of 26 species of Cladocera, two distinct genera of ostracods, several different turbellarian egg cocoons, *Chaoborus*, and several different midges were identified. Cladocera were by far the most abundant. Since most of the species have never been described in detail, most of the paper is devoted to systematic descriptions, especially of the chydorid Cladocera. Abundance graphs are included. Autogenic animal microfossil studies conform well with the zonation shown by pollen. There is also a correlation between the loss on ignition graph and the total chydorid Cladocera. Changes in abundance of all animals and of stability of the chydorid population indicates that the aquatic community was continually disturbed.—E.S.L.

5941 **Granger, Harry C.; Ingram, Blanche L.** Occurrence and identification of jordisite at Ambrosia Lake, New Mexico, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–B, p. B120–B124, tables, 1966.

Certain black-stained zones in sandstone associated with primary uranium ore bodies at Ambrosia Lake, N. Mex., contain as much as several tenths of a percent molybdenum. Chemical and X-ray studies of impure separates of the black material indicate that it contains appreciable amounts of the amorphous molybdenum disulfide, jordisite.—Authors' abstract

5678 **Green, P. E., Jr.; Frosch, R. A.; Romney, C. F.** Principles of an experimental Large Aperture Seismic Array (LASA): IEEE Proc., v. 53, no. 12, p. 1821–1833, illus., 1965.

A Large Aperture Seismic Array (LASA) for detection of small remote seismic events such as underground nuclear tests has been built and is in process of evaluation. It consists of a system of 525 seismometers over a 200 km aperture, signal transmission facilities, and signal processing hardware. Each seismometer is at the bottom of a 200-ft deep hole topped by a solid-state parametric preamplifer. Buried cable connects groups of 25 seismometers into subarrays; a subarray electronics module multiplexes and digitizes the 25 seismometer outputs into a single bit stream which is transmitted to a data center. Criteria to be applied to the teleseismic waveform to identify source of energy include geographic location, depth, first motion, complexity, and aftershock activity. Characteristics of signal and interferences and effect of array processing on them are discussed.—V.S.N.

Greene, Robert C. *See* Walker, George W. 5697

Grieves, W. A. *See* Levin, F. K. 5972

5861 **Griffiths, D. H.; King, R. F.** Applied geophysics for engineers and geologists: London, Pergamon Press, 223 p., illus., tables, 1965.

This text presents basic theories and techniques in geophysical methods of use to the civil engineer, geologist, or mining and petroleum engineers. The text has eight chapters as follows: introduction, theory of electrical resistivity surveying, the resistivity survey and its interpretation, the seismic method, seismic measurements and their interpretation, gravity surveying, magnetic surveying, and other geophysical methods.—V.S.N.

5903 **Grimaldi, F. S.; Shapiro, Leonard; Schnepfe, Marian.** Determination of carbon dioxide in limestone and dolomite by acid-base titration, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–B, p. B186–B188, tables, 1966.

Acid-base titration methods based on the dissolution of a sample in an excess of standard acid, followed by back titration with a standard base, have been developed for the rapid determination of carbon dioxide in limestone and dolomite. Difficulties arising from the solubility of some silicates are minimized by conducting the acid decomposition under mild conditions. In one procedure this is realized by overnight

digestion of the sample with acid at room temperature; in another procedure the sample is boiled for a short time with a predetermined, limited amount of excess acid.—Authors' abstract

Griscom, Andrew. *See* Blanchett, Jean. 5597

Griscom, Andrew. *See* Blanchett, Jean. 5598

Griscom, Andrew. *See* Blanchett, Jean. 5599

Griscom, Andrew. *See* Blanchett, Jean. 5600

5724 **Grissinger, Earl H.** Resistance of selected clay systems to erosion by water: Water Resources Research, v. 2, no. 1, p. 131–138, illus., tables, 1966.

Rates of erosion of selected clay systems were determined by subjecting molded samples to a uniform erosive force. Increased concentrations of clay minerals generally induced greater stability, but increased bulk densities had little influence. The influence of clay-particle orientation and antecedent water content was not consistent, but varied depending on the clay mineral mixture. Greater erosion rates occurred as the temperature of the eroding water was increased.—E.S.L.

Grossman, R. B. *See* Gile, L. H. 5969

Gualtieri, J. L. *See* Weir, G. W. 5691

5954 **Guinn, V. P.; Lukens, H. R., Jr.** Nuclear methods, Chap. 9 *in* Trace analysis, physical methods: New York, Interscience Publishers, p. 325–376, illus., tables, 1965.

Nuclear methods of two principal types are of interest in the field of trace analysis: activation analysis and radioactive tracer methods. The latter may be broken down into two forms: isotope dilution and radiometric analysis. These methods are defined and described in this chapter, the apparatus for each method and their applicability are discussed, as described in the literature. Although several authors have made submicrogram determinations, the potential of radioactive tracer methods has not been realized.—G.D.C.

5702 **Gutschick, R. C.** Transitional Devonian to Mississippian environmental changes in western Montana, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 171–181, illus., 1964 [1966].

Detailed studies have been made in portions of western Montana of the intersystemic cycle extending from the Jefferson Formation through the Lodgepole Limestone. The biostratigraphy of the succession, particularly the Sappington units, is discussed and summarized in a chart. Sappington fauna are illustrated, and the cyclical nature of the microfaunas in the Lodgepole Limestone is indicated on a chart.—E.S.L.

5952 **Guy, H. P.** System for monitoring fluvial sediment, *in* Selected techniques in water resources investigations, 1965: U.S. Geol. Survey Water-Supply Paper 1822, p. 84–88, illus., 1966.

The determination of fluvial-sediment concentration and discharge is expensive and hence limited in proportion to needs. A complete monitoring system based on (a) a continuous recording for fine sediment, (b) the use of existing gage-height records and theoretical considerations for coarse sediment, and (c) a central computing center is suggested to lower costs and improve the published statistics. With existing sampling equipment periodic measurements would be required to adjust the fine-sediment recording and shift the rating for coarse sediment similar to rating adjustments presently applied to computations for water discharge. The new system would make available many more kinds of statistics on a more timely basis than can be obtained by present techniques.—Author's abstract

5879 **Habashi, Fathi.** The mechanism of oxidation of sulfide ores in nature: Econ. Geology, v. 61, no. 3, p. 587–591, illus., table, 1966.

Kinetic evidence is presented showing that the oxidation of sulfide ores is an electrochemical process, similar to the corrosion of metals. The reactions taking place during the aqueous oxidation of zinc sulfide at a temperature below 120°C can be represented by the anodic reaction $ZnS \rightarrow Zn^{2+} + S + 2e$, and the cathodic reaction $1/2\ O_2 + H_2O + 2e^- \rightarrow 2OH$.—Author's abstract

5899 **Habib, Daniel; Riegel, Walter; Spackman, William.** Relationship of spore and pollen assemblages in the lower Kittanning coal to overlying faunal facies: Jour. Paleontology, v. 40, no. 3, p. 756–759, illus., 1966.

Five assemblages of dispersed spores and pollen were recognized in the lower Kittanning coal of western Pennsylvania. Evidence is presented for a genetic relationship between the distribution of the assemblages in the coal and the distributions of the overlying facies. Ecological factors assumed to have influenced spore and pollen distribution in the seam include marine transgression, salinity, edaphic conditions, slope and climate. Comparisons of spatial arrangements of the Kittanning assemblages are made with geometric arrangement of modern assemblages in southwestern Florida and similarities are pointed out.—S.H.M.

5785 **Hackett, O. M.** Ground-water research in the United States: U.S. Geol. Survey Circ. 527, 8 p., 1966.

The utilitarian urge has become so extreme that practically all funds available for ground-water work must be used in applying knowledge to specific surveys or water-supply problems, with virtually no opportunity for research work except as carried on inadequately and almost surreptitiously in connection with utilitarian projects. It is wasteful to apply the little now known instead of devoting a reasonable part of the effort to the fundamental task of developing basic principles of future worthwile application. What is primarily needed is not more money for ground-water work but a more rational use of money that is spent.—*from* Author's abstract

5893 **Hakalehto, Kalle.** Eräitä uusia piirteitä kiven rikkoontumisesta [with English summ.]: Vuoriteollisuus-Bergshanteringen, v. 24, no. 1, p. 55–57, illus., 1966.

Some new ideas concerning rock failure according to Griffith's theory and its modifications are presented; results indicate that failure exists through splitting parallel to the maximum compression. This mode of failure is then applied to practical observations. Laboratory tests agree closely with the theory. The conditions of macroscopic failure in mines can be understood very well according to this type of failure. Some applications are given concerning strengthening in mines.—*from* Author's English summary

5977 **Halbouty, Michel T.** Economics—New dimension in geological thinking: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 830–845, illus., 1966.

The petroleum industry of today has four dominant types of problems—geological, technological, political, and economical. The geologist in this industry must face the fact that to become effective as an explorer or developer, he must become more involved and astute in all of these phases now and in the future.—V.S.N.

5768 **Hall, Charles E.; Carlson, J. Wendel.** Stabilization of soils subject to hydrocompaction: Eng. Geology, v. 2, no. 2, p. 47–58, illus., table, 1965.

Twenty miles of the 110-mile long San Luis Canal, under construction in the San Joaquin Valley of California, are in low density soils which collapse when water is applied to them for the first time. These soils, high in montmorillonite, are interfan deposits between major drainages, and have not been saturated since deposition. More than 400 holes were drilled and samples taken, and six 125-ft square test ponds were installed and observed for periods up to one year. Areas subject to hydrocompaction were treated by ponding water and saturating the soil. Settlements were extremely erratic, ranging up to five feet generally. Initial subsidence rate was as much as 1.5 ft per month, then stabilized at about 0.1 ft after three to six months. Complete stabilization was never achieved, but the remaining subsidence is believed to be small enough that it will not affect the canal.—E.S.L.

5755 **Hall, Clarence A.; Turner, Donald L.; Surdam, Ronald C.** Potassium-argon age of the Obispo Formation with *Pecten lompocensis* Arnold, southern Coast Ranges, California: Geol. Soc. America Bull., v. 77, no. 4, p. 443–445, illus., 1966.

Fossiliferous rhyolitic tuff and breccia of the Obispo Formation has given a K-Ar age of 20.9±1.5 m.y. on plagioclase sampled from the middle of the unit. Intrusive andesite-dacite porphyry from Morro Rock is dated at 23.5±1.8 m.y. by the same method.—J.G.V.

5889 **Hall, George Frederick.** Geomorphology and soils of the Iowan-Kansan border area, Tama County, Iowa [abs.]: Dissert. Abs., v. 26, no. 10, p. 5624, 1966.

5631 **Hall, H. T.** Application of thermochemical data to problems of ore deposition [discussion of article by H. D. Holland, 1965]: Econ. Geology, v. 61, no. 3, p. 622–623, tables, 1966.

The reactions and recalculated free energy values are listed for several sulfosalts containing more than one metal as corrections to data in Holland's paper (ibid., v. 60, p. 1101–1167, 1965).—W.S.W.

5744 **Hall, N. Timothy.** Late Cenozoic stratigraphy between Mussel Rock and Fleishhacker Zoo, San Francisco Peninsula, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 151–158, illus., 1965.

A mile-thick section of late Cenozoic marine and continental sediments, exposed in the sea cliff south of San Francisco, can be divided into three rock-stratigraphic units, separated by unconformities: the Merced Formation of Pliocene-Pleistocene age, the Colma Formation of late Pleistocene age, and 500 feet or more of unnamed Pleistocene beds between the two. The marine Merced Formation parallels the San Andreas Fault southeastward across the San Francisco Peninsula. The fossil assemblage suggests a correlation of the lower member with the type San Joaquin Formation. The base of the upper member is drawn at a striking change in heavy minerals, indicating a change in source from local bedrock to drainage from the Great Valley through San Francisco Bay. Geologic relations are shown in sketches. The younger Colma Formation is undeformed.—G.D.C.

5662 **Hambleton, William W.** Education of geologists for geological surveys: Jour. Geol. Education, v. 14, no. 3, p. 83–86, 1966.

In modern state geological surveys, the potential survey employee faces the paradox of requirements for a specialist, along with the versatility of a generalist. In addition, he may be in an environment conducive to a career of lifetime learning or professional deterioration. The educational pattern for such a geologist should be one that encourages capability for transference of ideas from one discipline to another, a reasonably high level of specialization, and capacity for self-starting study and investigation.—*from* Author's abstract

Han, Mark C. *See* Ralph, Elizabeth K. 5747

Hanshaw, Bruce B. *See* Back, William. 5983

5633 **Harden, G.** Cobalt—Useful but neglected in geochemical prospecting [discussion of paper by F. C. Canney and L. A. Wing, 1966]: Econ. Geology, v. 61, no. 3, p. 625–626, 1966.

Use of field methods for analysis may lead to erroneous results where comparisons are made between metal contents of rocks in various stages of decomposition, because field methods do not always involve total extraction. (See Canney and Wing, ibid., no. 1, p. 198–203).—W.S.W.

Hardt, W. F. *See* Kister, L. R. 5686

5575 **Hardy, Henry Reginald, Jr.** The experimental investigation of the inelastic behavior of geologic materials [abs.]: Dissert. Abs., v. 26, no. 10, p. 5960, 1966.

5589 **Harmison, Lowell Thomas.** Derivative neutron activation analysis of zinc [abs.]: Dissert. Abs., v. 26, no. 10, p. 6110, 1966.

5704 **Hart, Thomas; Lane, William H.** Longwall method modified for U_3O_8: Eng. and Mining Jour., v. 167, no. 7, p. 79, illus., 1966.

A mining method is described for extracting stratigraphically controlled pre-fault uranium ore contained in the Westwater member of the Morrison Formation at Ambrosia Lake, N. Mex. The pre-fault ore is primary and usually high grade with large variations in thickness and lateral dimensions.—W.L.E.

Hartshorn, Joseph H. *See* Colton, Roger B. 5613

6003 **Hastrup, Ole F.** Surface waves from 1000 lb TNT charge buried 23.5 feet deep: Geoexploration, v. 3, no. 2, p. 85–104, illus., table, 1965.

An experimental study was carried out in 1962 at Suffield Experimental Station, Alberta, to obtain information on generation of seismic surface waves and cratering mechanism from buried charges. A series of 1,000 lb TNT shots were fired. One charge, a cast sphere buried at 23.5 feet in the Juniper Flats–Watching Hill area, is discussed here. Results show that surface waves generated by the shot consisted of several pulses in the vertical-radial plane; two very dominant—a prograde followed by a retrograde—are interpreted as the fundamental Sezawa wave (M_{21} wave) and the fundamental Rayleigh. The first of two pulses in the transverse trace is coupled to the Sezawa and the second could be the Love wave. An appendix describes the use of Fourier integrals or transforms to obtain phase velocity and explains how procedures used differ from those of Sato. Instrumentation and data processing are discussed.—V.S.N.

5701 **Hattin, Donald E.** Cyclic sedimentation in the Colorado Group of west-central Kansas, *in* Symposium on cyclic sedimentation: Kansas Geol. Survey Bull. 169, v. 1, p. 206–217, illus., 1964 [1966].

The Colorado Group records deposition during the Greenhorn cyclothem and part of the second Late Cretaceous cycle. Stratigraphy, sedimentary structures, texture, composition, and fossils in the lower cyclothem indicate successive change from marginal and nearshore, shallow deposition in phases 1 and 2 to far offshore deposition in deep saline water in phase 4, and return to nearer shore, shallower water deposition through phases 5 to 7. Regression is recorded chiefly in the increased quantity and grain size of terrigenous detritus.—E.S.L.

5553 **Havens, John S.** Recharge studies on the High Plains in northern Lea County, New Mexico: U.S. Geol. Survey Water-Supply Paper 1819-F, p. F1–F52, illus., tables, 1966.

Hydrologic boundaries isolate the main aquifer of the area, the Ogallala Formation, from outside sources of natural recharge other than precipitation. Estimated long-term average annual recharge is about 77,000 acre-feet—from precipitation and returns from irrigation pumping; discharge from the aquifer is by pumping and underflow. Estimated average annual discharge exceeds recharge by about 69,000 acre-feet. In 1950–60 the general net decline of the water table was 10 feet and as much as 30 feet locally. When precipitation is normal about 100,000 acre-feet of water collects in closed surface depressions of the High Plains; 20–80 percent of this loss recharges the aquifer, the balance is lost principally by evaporation. Artificial recharge facilities in the depressions could put at least 50,000 acre-feet of water underground annually that otherwise would be lost to evaporation.—*from* Author's abstract

5809 **Hawley, John W.; Wilson, William E., 3d.** Quaternary geology of the Winnemucca area, Nevada: Nevada Univ. Desert Research Inst. Tech. Rept. 5, 66 p., illus., tables, geol. maps, 1965.

This area, including a 44 mi segment of the terraced Humboldt River valley, was occupied at least twice by late Pleistocene Lake Lahontan. Subdivisions of valley-fill alluvium are based on lithology, relationship to lacustrine deposits, soil

development, and geomorphic expression. Pre-Sehoo alluvium, exposed on upper parts of most aprons, underlies degradational surfaces cut by piedmont scarps and Lahontan shorelines. Post-Sehoo alluvium, under aggradational surfaces, includes up to ten feet of Recent fan deposits. Cone shapes of fans have persisted where periodic faulting has occurred; with more stable conditions, alluvial slopes and pediments formed, mostly in pre-Lahontan semiarid interpluvial periods. In the valley of the meandering Humboldt River, intertonguing units of the Lahontan Valley Group include a major aquifer of sand and gravel, overlain by vertical and horizontal accretion deposits of the flood plain.—G.D.C.

Hedge, C. E. *See* Doe, B. R. 5649

5918 **Heindl, L. A.** Groundwater in the Southwest—A perspective, *in* Ecology of groundwater in the southwestern United States—Symposium, Arizona State Univ., 1961: Tempe, Ariz., Am. Assoc. Adv. Sci., Southwest and Rocky Mtn. Div., and Ariz. State Univ. Bur. Publications, p. 4–26, illus., 1965.

Quantitative estimates of water resources given in this report are only broadly representative; many local conditions introduce a 20 percent margin of error. Ground water stored in rocks within a few hundred feet of the surface is more than enough to supply the Southwest for 200 yr. The water-bearing capacity of these rocks is huge, but steady decline of water tables in many areas is indisputable evidence that present demands outstrip the extent to which supply is replenished. Over 10 billion acre-feet are in storage, perhaps 20 percent available to wells; annual withdrawal is on the order of 10 million acre-feet, with negligible recharge except in flood-plain and limestone deposits of the southwestern Great Plains. Regardless of good management, the Southwest will have to obtain a quarter of its requirement from ground water in storage; even in contrast to the present two thirds, supplies will continue to be depleted.—G.D.C.

5916 **Heinrichs, Walter E., Jr.; Seward, Franklin A., Jr.** Geophysics in groundwater studies, *in* Ecology of groundwater in the southwestern United States—Symposium, Arizona State Univ., 1961: Tempe, Ariz., Am. Assoc. Adv. Sci., Southwest and Rocky Mtn. Div., and Ariz. State Univ. Bur. Publications, p. 64–70, illus., 1965.

The selection of a suitable geophysical method for water exploration is dependent on competent geological analysis of the geometry and expected physical property contrasts. Of the several methods considered, only resistivity, or possibly induced polarization, are generally applicable to the four geohydrological situations described: alluvial-filled erosional channels on bedrock; facies control within the alluvium; facies channeling in sedimentary rocks; and fracture or fault control in sedimentary or crystalline bedrock. Indirect methods—gravity, magnetics, and seismic—may be used in broad, deep channels or basins; these rely on measurement of subsurface physiographic or structural variations which may control the location and flow of water.—G.D.C.

5572 **Hellerman, Joan.** The fossil diatoms of the Mohonk Lake area, New York and their ecological significance [abs.]: Dissert. Abs., v. 26, no. 10, p. 5675, 1966.

5601 **Henderson, J. R.; Andreasen, G. E.; Petty, A. J.** Aeromagnetic map of northern New Jersey and adjacent parts of New York and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP-562, scale 1:125,000, 1966.

5623 **Hersey, J. B.** Sound reflections in and under oceans: Oceanus, v. 12, no. 2, p. 14–23, illus., 1966.

The study of pelagic fishes by means of sound scattering and of sediments in ocean basins by means of sound reflection are among the most useful applications of physics to oceanography. Geophysicists, since the mid-30's, have found in oceans a vast treasure of basic information about the Earth's crust which has profoundly influenced concepts of dynamics of the Earth. Early observations and developments in methods and apparatus are reviewed. Reflection profiles are shown for Narragansett Bay, R. I., obtained by using the earliest type of sparker; for an east-west line 100 miles north of Madeira, obtained with a 5000-joule boomer at a speed of three knots; and for the Puerto Rico Trench, one taken in more than four miles

of water reflecting 1.5 to 2.0 km below the sea floor, and another over the north wall showing outcrops of sediment layers.—G.D.C.

5924 **Hershey, Robert E.** Mineral resources summary of the Slayden quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 14 p., table, 1966.

This text accompanies Tennessee Div. Geology Geol. Map GM 302-SW by O. T. Marsh (cited separately) and describes the iron ore and chert resources in the Slayden quadrangle. Iron ore deposits are on hills or slopes of hills, generally enclosed in a chert, clay, and silt residuum derived by weathering of St. Louis Limestone carbonate rocks; they may be present also in the Warsaw and Fort Payne Formations. Ores consist largely of limonite, goethite, and other hydrated ferric oxides plus small amounts of hematite and magnetite; they are epigenetic and presumed to have been derived from glauconite in Cretaceous or younger formations. Chert in the quadrangle is residual material derived from the Mississippian Fort Payne, Warsaw, and St. Louis Formations; all pits are inactive. Potential resources are gravel and limestone.—M.C.M.

6015 **Hess, H. H.** Mid-oceanic ridges and tectonics of the sea floor, *in* Submarine geology and geophysics—Colston Research Society Symposium, 17th, Bristol, England, 1965, Proc.: London, Butterworths, p. 317–332, illus., 1965.

Continental drift is assumed; the postulated mechanism is related to convection in the upper mantle. Mid-oceanic ridges are correlated with rising limbs of the convecting system and are ephemeral in character. Thus the Darwin Rise is recently deceased, the Mid-Atlantic Ridge is mature and active, and the East Pacific Rise is just about to be born. The oceanic crust is serpentinized peridotite—hydrated mantle material—and is being continually formed on the crests of ridges, moving laterally away from the crests and finally disappearing downwards under trenches or cordillera-flanked coasts. It is a disposable crust inasmuch as dehydration on its downward course regenerates peridotite; the ocean-floor may thus be renewed every few hundred million years. Linear magnetic anomalies of the sea-floor and ophiolites are discussed with respect to mid-oceanic ridges.—*from* Author's abstract

5648 **Hewett, D. F.** Stratified deposits of the oxides and carbonates of manganese: Econ. Geology, v. 61, no. 3, p. 431–461, illus., tables, 1966.

Review of layered deposits of manganese oxides and carbonates throughout the world indicates that most of the large concentrations are in Precambrian or Tertiary rocks. Iron is generally 30 to 90 times as abundant as manganese in ordinary rocks, whereas iron is subordinate to manganese in most bedded manganese deposits. The lack of complementary iron deposits in basins containing manganese deposits therefore suggests that the rocks surrounding the basin are not an adequate source. Upward increase in the Mn-Fe ratio in hydrothermal deposits, together with common evidence for contemporaneous vulcanism, favor an exhalative sedimentary origin.—W.S.W.

5830 **Hickox, Charles F.** Glacial drainage channels crossing North Mountain, Annapolis County, Nova Scotia: Maritime Sediments, v. 2, no. 2, p. 76–79, illus., 1966.

North Mountain, a cuesta of Triassic basalt flows dipping to the north, forms the coast line of the area, and South Mountain, a granite-cored upland, forms the backbone. Between them is the subsequent Annapolis Valley, eroded in Triassic strata. Dry gaps breach the crest of North Mountain opposite most of the major consequent streams flowing northward from South Mountain to the Annapolis River. Two of these gaps, formed by channels ending in a delta on the Fundy shore, are described. It is suggested that the wind gaps were cut by streams before being beheaded by the Annapolis, perhaps in Cretaceous time. Drainage crossed the crest again during ablation of two stages of continental glaciation, then ceased and present patterns were established.—E.S.L.

5910 **Hill, Harry M.** Bed forms due to a fluid stream: Am. Soc. Civil Engineers Proc., v. 92, paper 4724, Jour. Hydraulics Div., no. HY2, p. 127–143, illus., table, 1966.

A relationship was determined for finding the point at which ripples would replace the flat bed of a stream, depending, as the shear decreases, on where the coefficient of dynamic friction becomes larger than the coefficient of static friction. An empirical relationship for determining this point was found to be applicable for all experiments in which sand was used as bed material. The depth of the collision region in terms of mean diameter was nearly constant for all sand runs when dunes appeared from the flat bed; a variance of 14 percent was tolerable because many different sands were used. Experiments with Perspex showed a discrepancy with sand of a different density. More detailed study of the shear stress on the backs of the dunes is needed to determine the point at which dunes cease to exist and ripples take their place.—G.D.C.

5753 **Hill, Mason L.; Troxel, Bennie W.** Tectonics of Death Valley region, California: Geol. Soc. America Bull., v. 77, no. 4, p. 435–438, illus., 1966.

The north-northwest trending Death Valley and Furnace Creek right lateral strike-slip fault zones border the Black Mountains, Calif. Other tectonic features in the Death Valley region appear compatible with this strike-slip strain system of northeast-southwest shortening and northwest-southeast relative extension. Accordingly, some of the Basin and Range structures of Tertiary to Recent age may be characterized by strike-slip rather than dip-slip faulting, and result from compressional rather than tensional dynamics.—Authors' abstract

5944 **Hinkle, Margaret; Leong, Kam Wo; Ward, F. N.** Field determination of nanogram quantities of mercury in soils and rocks, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B135–B137, tables, 1966.

A method for determining nanogram quantities of mercury in geological materials is based on the catalytic effect of mercury on the reaction of ferrocyanide with nitrosobenzene to produce a violet colored compound whose intensity is proportional to the mercury present. The mercury is released by heating a sample of soil or crushed rock to about 650°C. As little as 30 nanograms of mercury (30 parts per billion in a 1-gram sample) can be detected. The reliability of the method is adequate to permit its use in geochemical surveys that utilize mercury as a pathfinder element.—Authors' abstract

Ho, Show-jy. *See* Schrenk, W. G. 5620

5751 **Ho, Tong-Yun.** Stratigraphic and paleoecologic applications of water-insoluble fraction of residual shell proteins in fossil shells: Geol. Soc. America Bull., v. 77, no. 4, p. 375–392, illus., tables, 1966.

The water-insoluble fraction of residual shell proteins of late Cenozoic non-marine molluscs from 33 localities in the midcontinent region was isolated by decalcification, dialysis and filtration. Results indicated: consistent decrease in shell protein nitrogen (SPN) from Recent to early Pliocene, similar SPN values in related taxa within a given stratigraphic unit regardless of species or geography, and a statistically significant difference in SPN between adjacent stratigraphic units. SPN values may thus be used in stratigraphic correlation.—J.J.H.

5568 **Hobson, Richard David.** An environmental study of the Vaqueros Formation, Santa Ynez Mountains, California [abs.]: Dissert. Abs., v. 26, no. 11, p. 6644, 1966.

5992 **Hoekstra, T. E.; Osterkamp, T. E.; Weeks, W. F.** Migration of liquid inclusions in single ice crystals: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 183, 8 p., illus., tables, 1965.

The migration of brine pockets of KCl and NaCl under the influence of a temperature gradient was investigated in single ice crystals obtained from Mendenhall Glacier, Alaska. Although relative movements were consistent with theoretical diffusion, observed velocities were less than those calculated from a model using data on electrolytic solutions available in the literature. Neither the direction of the gravitational field nor the crystallographic orientation of the host crystal significantly influenced the rate of migration. In the temperature range of most

sea ice, the brine pockets contain only a small amount of solid salt in extremely fine crystals which are swept ahead of the ice brine interface until the brine pockets are frozen solid. Because such low temperatures for sea ice are rare, pronounced changes in ratios of the major salts should not be expected.—G.D.C.

Hoffman, C. M. *See* Stewart, G. L. 5786

Hollenstein, G. H. *See* Cotter, R. D. 5608

5646 **Holman, J. Alan.** A huge Pleistocene box turtle from Texas: Florida Acad. Sci. Quart. Jour., v. 28, no. 4, p. 345–348, illus., table, 1965.

A complete plastron of *Terrapene* sp., 269 mm in median length, was collected from Trinity River terrace deposits at the Lewisville site, thought to be of Sangamon age, in southern Denton County, Tex. Studied from a cast, the specimen is compared with Pleistocene and Recent species of *Terrapene* from Florida and Texas. It closely resembles plastra of living *T. carolina carolina*, though twice as long. It is larger than the largest recorded Texas form, *T. marnocki*, and approaches the maximum size of *T. carolina putnami* from the late Pleistocene of Florida.—V.M.J.

5672 **Holtz, W. G.** Volume change, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 448–465, illus., 1965.

For consolidation tests on soils the apparatus needed includes a consolidometer, a loading device, and a device for cutting undisturbed specimens and for preparation of remolded specimens. Procedure is described in detail from specimen preparation to measuring rebound. Calculation instructions include data sheets and examples of data plotting and instructions on report writing are given. Expansion and shrinkage tests use the same apparatus as consolidation; procedures are described.—E.S.L.

Hopkins, M. E. *See* Simon, J. A. 5826

5933 **Hose, Richard K.** Devonian stratigraphy of the Confusion Range, west central Utah, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B36–B41, illus., 1966.

Devonian strata in the Confusion Range, in west central Utah, are more than a mile thick and are subdivided into four formations. In ascending order these are the Sevy Dolomite, Simonson Dolomite, Guilmette Formation, and Pilot Shale. The Sevy Dolomite is virtually unfossiliferous, but on the basis of regional considerations it is presumed to be of Devonian age. The Pilot Shale yields Devonian fossils from its lower half; however, the upper part, locally at least, contains a fauna of Early Mississippian age.—Author's abstract

5705 **Howard, Alan D.** Verification of the "Mischungskorrosion" effect [discussion of "Mischungskorrosion—Ein Beitrag zum Verkarstungsproblem" 1964, by A. Bögli]: Cave Notes, v. 8, no. 2, p. 9–12, 1966.

Bögli (Erdkunde, v. 18, p. 83–92, 1964) points out important changes in the ability of ground water to dissolve limestone when two sources of different dissolved CO_2 content mix. Howard took several pairs of values of initial saturation concentrations of dissolved calcite used by Bögli and computed the concentrations of the components of these original solutions, and assuming a given ratio of mixing of two of these, determined the new value of the equilibrium concentrations. The results demonstrated the existence of the effect, and similar calculations for different concentrations and ratios agreed.—E.S.L.

5797 **Howard, Leonard W.; Schoewe, Walter H.** The Englevale channel sandstone: Kansas Acad. Sci. Trans., v. 68, no. 1, p. 88–106, illus., 1965.

The Englevale Sandstone is a river channel type of sandstone of Pennsylvanian age cropping out in eastern Bourbon and northern Crawford Counties in Kansas, and western Vernon County, Mo. It consists of sheet and channel facies, and cuts

through formations from the Verdigris to Fort Scott. The Mulky coal has been removed in places. The lithology of the sandstone and basal conglomerate, and structural features are described. Interpretations of events recorded by the Englevale are given, and possible stages in the history of the river shown in drawings.—E.S.L.

5638 **Hriskevitch, M. E.** Wraps removed from Rainbow: Canadian Petroleum, v. 7, no. 4, p. 23–25, 27, 30, illus., table, 1966.

The Rainbow discovery well is located about 180 mi north-northwest of Peace River, Alberta, in the Elk Point evaporite basin. Stratigraphy of the Devonian Elk Point Group penetrated by the well is given. Below this group the well entered Precambrian granite. Formation tops and pay zones in the three wells comprising the Rainbow A pool are listed.—E.S.L.

5904 **Huffman, Claude, Jr.; Mensik, J. D.; Rader, L. F.** Determination of silver in mineralized rocks by atomic-absorption spectrophotometry, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B189–B191, tables, 1966.

A rapid and precise atomic-absorption spectrophotometric method for the determination of silver in mineralized rocks is described. The procedure consists of digesting the sample with nitric acid, centrifuging the diluted solution, and atomizing it into an atomic-absorption spectrophotometer for measurement of silver at a wavelength of 3,284 A. Silver ranging in concentration from 1 ppm to about 9,000 ppm (or about 0.03 to 250 oz troy/ton) can be determined without preliminary separations even in the presence of high concentrations of diverse elements.—Authors' abstract

5795 **Humphrys, C. R.** (editor). Anatomy of a watershed, Red Cedar River, Michigan: East Lansing, Mich., Michigan State Univ., Dept. Resource Devel., 300 p., illus., tables [1966].

Data on anatomy of a small watershed collected by students is presented without any effort toward analysis or interpretation. It may be useful as a guide line for types of data available and required for development of a watershed management program. This report is also an exercise in data collection and presentation, considerable effort being devoted to new and seldom used parameters.—E.S.L.

Hunkins, Kenneth L. *See* Cabaniss, G. H. 5698

Hunt, C. B. *See* Stern, T. W. 5946

Hutchinson, G. E. *See* Cowgill, Ursula M. 5540

Hutchinson, G. E. *See* Cowgill, Ursula M. 5541

5558 **Hutchinson, G. E.; Goulden, C. E.** The plant microfossils, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 67–73, illus., 1966.

A quantitative study was carried out on unicellular and vascular plant fossils in two cores of lake sediments going back to 4,000 B.P. Grass fragments and remains of *Botryococcus* were the most abundant. Colonies of *Pediastrum, Microasterias, and Staurastrum* were very scarce. Abundance and distribution diagrams are included.—E.S.L.

Huxel, Charles J., Jr. *See* Rush, F. Eugene. 5731

5615 **Hyden, Harold J.** Geologic map of the McFadden quadrangle, Carbon County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-533, scale 1:24,000, sections, text, 1966.

Petroleum and natural gas are produced from a number of formations in the McFadden quadrangle. Since its discovery in 1918, 120 wells have been drilled in the Rock River field. Coal occurs in four formations but production has been

small. Alluvial gravel covering large areas is a potential source of road metal.—M.C.M.

Ingram, Blanche L. *See* Granger, Harry C. 5941

5745 **Internat. Assoc. Quaternary Research.** Guidebook for Field Conference I, Northern Great Basin and California—INQUA, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., 165 p., illus., tables, geol. maps, 1965.

This field trip crosses the Rocky Mountains and northern Colorado Plateau by railroad, studies Lake Bonneville and Lake Lahontan (see also Conference trip E), considers glacial and volcanic deposits and Quaternary tectonism of the east side of the Sierra Nevada, and then crosses the Sierra Nevada and the Great Valley and Coast Ranges to study marine terraces, drowned valleys, and Quaternary tectonics in the Coast Ranges. Areas described within this guidebook are cited individually. A supplement, by R. B. Morrison, describes the area between Denver, Colo., and Salt Lake City, Utah.—G.D.C.

Ito, Jun. *See* Frondel, Clifford. 5958

6000 **Izett, Glen A.** Tertiary extrusive volcanic rocks in Middle Park, Grand County, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B42-B46, illus., 1966.

Middle and late Tertiary volcanism along Rabbit Ears Range, Colo., produced extrusive rocks that extend from the crest of the range into the Hot Sulphur Springs quadrangle, Middle Park, Colo. These rocks are here divided into two newly named units—Rabbit Ears Volcanics (Oligocene and Miocene?), and Grouse Mountain Basalt (Pliocene?). The latter, comprising basalt flows 0-500 feet thick, is locally separated from the Rabbit Ears by the Troublesome Formation (Miocene). In the Hot Sulphur Springs quadrangle, the Rabbit Ears unconformably overlies Middle Park Formation (Late Cretaceous-early Tertiary) and includes a lower unit of trachybasalt lavas here named the Pete Gulch Member, 0-200 feet thick, and an overlying unit of interlayered tuff breccia, tuffs, and latite lavas, 0-800 feet thick. A K-Ar age of 33±3 m.y. was obtained from rhyolite breccia near the middle of the Rabbit Ears Volcanics.—*from* Author's abstract

5881 **Jackson, M. L.** Free oxides, hydroxides, and amorphous aluminosilicates, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 578-603, illus., tables, 1965.

The selective dissolution methods presented for mineralogic analysis of soils include the $Na_2S_2O_7$-HCl-NaOH method for quartz and feldspars, and the flash-heating NaOH-dissolution method for allophane, gibbsite, and amorphous oxides of aluminum and silicon. The determination of allophane by the cation-exchange capacity method is also given. Rutile and anatase can be detected by X-ray techniques after siliceous materials are dissolved with cold HF.—E.S.L.

5670 **Jackson, Ray D.; Taylor, Sterling A.** Heat transfer, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 349-360, 1965.

The properties of soil which govern the flow of heat through it are of interest to several disciplines. The heat-transfer coefficients of thermal conductivity and diffusivity are discussed. Description of the methods of measurement includes special apparatus, procedure, and calculation.—E.S.L.

5714 **Janda, Richard J.** Great soil groups on the west slope of the central Sierra Nevada, California, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 121-123, illus., 1965.

The great soil groups in this area show a pronounced vertical zonation, profiles of which are shown here. Closely following the life zones, the valley and lower part have noncalcic brown soils, peculiar to California; higher are prairie soils, with differences related to parent material. Most of the soils are in the transition zone where large differences in parent material have had little effect on final profiles, even the differences between pre-Wisconsin till and bedrock outside the limits of glaciation. At higher altitudes the soils become more and more shallow lithosols. There is no reason to believe that these soils are not in equilibrium with present climate and ecology.—G.D.C.

5716 **Janda, Richard J.** Quaternary alluvium near Friant, California, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 128–133, illus., 1965.

Near Friant the San Joaquin River flows from the bedrock foothills onto its alluvial plain, which occupies an embayment between two tilted mesas capped by Tertiary formations. In the embayment at least five alluvial deposits, separated by erosional unconformities, form rolling terraces high above the present river and downstream from Friant; an unusual silty constituent may have originated as glacial rock flour from the Sierra Nevada. Most of the pebbles and cobbles are of granitic rocks, basalt, or schist. Sixty feet of rhyolitic pumice related to the Bishop Tuff rest on a weathered surface of older alluvium with 25 feet of relief. Because the soils are more developed than those on Tahoe drift, the alluvium probably predates the Tahoe glaciation.—G.D.C.

5569 **Jemmett, Joe Paul.** Geology of the Northern Plomosa Mountain Range, Yuma County, Arizona [abs.]: Dissert. Abs., v. 26, no. 11, p. 6645, 1966.

5806 **Jewett, J. M.** [Walter H. Schoewe, 1891–1966]: Kansas Acad. Sci. Trans., v. 68, no. 4, p. 516, portrait, 1965 [1966].

5570 **Johnson, Gerald Homer.** The stratigraphy, paleontology, and paleoecology of the Peoria loess (upper Pleistocene) of southwestern Indiana [abs.]: Dissert. Abs., v. 26, no. 11, p. 6645, 1966.

Kaarsberg, Ernest A. *See* Wilson, Stanley D. 5726

5688 **Kachadoorian, Reuben.** Effects of the earthquake of March 27, 1964, at Whittier, Alaska: U.S. Geol. Survey Prof. Paper 542-B, p. B1–B21, illus., tables, 1965.

The earthquake in south-central Alaska on March 27, 1964, took the lives of 13 persons and caused more than 5 million dollars worth of damage to Government and private property at Whittier. Loss of life was due to waves; property damage was caused by a 5.3-ft subsidence of the land mass, seismic shock, compaction and fracturing of unconsolidated deposits and fill, submarine landslides, waves generated by the submarine landslides, and fire. The chief conclusion drawn from the investigation is that damage can be correlated with the local geology. All facilities built on the slate and graywacke bedrock were damaged slightly, or not at all, whereas most buildings on unconsolidated sediments or fill were damaged significantly by the seismic activity.—W.L.G.

5661 **Kanehiro, Yoshinori; Sherman, G. Donald.** Fusion with sodium carbonate for total elemental analysis, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 952–958, 1965.

The total elemental analysis of soils requires conversion of insoluble materials to soluble forms. The most convenient method is fusion with various fluxes. Methods for $NaCO_3$ fusion, and for preparation of the fusion for analysis are described.—E.S.L.

5632 **Kays, M. Allan.** Petrographic and modal relations, Sanford Hill titaniferous magnetite deposit [reply to A. F. Buddington's discussion, 1966, of paper by Kays, 1965]: Econ. Geology, v. 61, no. 3, p. 624–625, 1966.

Keefer, W. R. *See* Ketner, K. B. 5859

5582 **Kent, Harry Christison.** Biostratigraphy of the lower Mancos Shale (Cretaceous) in northwestern Colorado [abs.]: Dissert. Abs., v. 26, no. 10, p. 5976, 1966.

5859 **Ketner, K. B.; Keefer, W. R.; Fisher, F. S.; Smith, D. L.; Raabe, R. G.** Mineral resources of the Stratified Primitive Area, Wyoming: U.S. Geol. Survey Bull. 1230-E, p. E1-E56, illus., tables, geol. map, 1966.

The older group of formations of the Stratified Primitive Area, composed of limestone, sandstone, and shale cropping out in two of the deeper valleys, were intricately folded, faulted and deeply eroded 70 m.y. ago, then covered by a younger group of formations composed of volcanic rocks plus sandstones and conglomerates. Ground traverses and geochemical analyses of stream sediments and altered rocks reveal a sporadically mineralized area southeast of Kirwin mining district which has a potential for concealed deposits and is worthy of further exploration. Deposits of coal, bentonite, and phosphate are found in adjacent areas in the same sedimentary formations that underlie parts of the primitive area, but if they exist in the study area, they are too deeply buried to be mined economically.—*from* Authors' abstract

King, R. F. *See* Griffiths, D. H. 5861

5837 **Kirkby, Edward.** Geology of the Red Cedar Watershed, *in* Anatomy of a watershed, Red Cedar River, Michigan: East Lansing, Mich., Michigan State Univ., Dept. Resource Devel., p. 22-29, geol. map [1966].

Bedrock of the watershed is of Mississippian-Pennsylvanian age, but the river and its tributaries are almost completely channeled in Pleistocene drift. Glacial features in the area are described. The ancestral Red Cedar River, carrying glacial meltwater, was 3/4 mi wide and was strong enough to cut through two moraines. As the volume of water diminished, sediment was deposited in the valley, with coarser material near the center. The river now is mature, with a meandering channel, wide flood plains, and low gradient.—E.S.L.

5686 **Kister, L. R.; Hardt, W. F.** Salinity of the ground water in western Pinal County, Arizona: U.S. Geol. Survey Water-Supply Paper 1819-E, p. E1-E21, illus., tables, 1966.

Chemical quality of ground water in western Pinal County is nonuniform areally and stratigraphically; striking differences have been noted from different depths in the same well. Change in water quality can be correlated with sediment types; upper and lower sand and gravel units yield water of better quality than the intermediate silt and clay unit which in places contains zones of gypsum and common table salt. Highly mineralized ground water near Casa Grande has moved southward and westward as much as four miles, similar water near Coolidge a lesser distance. Good management practices and proper use of soil amendments have made possible use of water high in salinity and alkali hazard in agriculture. Fluoride content of ground water is unusually low except water from sediments that contain certain volcanic rocks.—*from* Authors' abstract

Kistler, James O. *See* Gallear, Darrell C. 5728

5543 **Kistler, R. W.; Bateman, P. C.** Stratigraphy and structure of the Dinkey Creek roof pendant in the central Sierra Nevada, California: U.S. Geol. Survey Prof. Paper 524-B, p. B1-B14, illus., geol. map, 1966.

The Dinkey Creek roof pendant, northeast of Fresno in the central Sierra Nevada, Calif., is a sequence of five sedimentary formations of Paleozoic or Mesozoic age, which bordering plutons have thermally metamorphosed to the hornblende hornfels facies. During three successive tectonic episodes, three fold systems were formed. The first folds are overturned and have tightly appressed limbs; axial surfaces strike about N. 5° E. and dip 45° W. Second folds are open and have simple hinges; near-vertical axial surfaces strike about N. 20° W. The third folds are open and

have simple hinges; near-vertical axial surfaces strike about N 60° W. Deformations that produced the folds are thought to be regional.—*from* Authors' abstract

5643 **Kittrick, J. A.** Electron-diffraction techniques for mineral identification, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 653–670, illus., 1965.

Electron diffraction differs from X-ray diffraction in that relatively few atomic layers are penetrated. In transmission electron-diffraction, the electrons pass through a very thin specimen. If the crystals are relatively thick with thin edges, most of the diffraction will occur at the edges. A single crystal will produce a different pattern than will a powdered sample. Reflection electron-diffraction patterns are obtained from an electron beam oriented nearly parallel to the surface of the specimen. This method is advantageous in examining a surface which cannot be removed from a substrate that is opaque to electrons. This may become the preferred method for soil analysis.—E.L.

5676 **Kittrick, J. A.** Electron microscope techniques, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 632–652, illus., 1965.

The value of the electron microscope for mineral identification is limited because it cannot be used to obtain refractive indexes and does not have polarizing features. It can be applied to the structure of materials having a degree of organization, to the study of processes, and to particle size and shape studies. The microscope is described in detail, and specimen preparation and the enhancing of specimen definition discussed. Sources of information on electron microscopy are included.—E.S.L.

Knipping, H. D. *See* Edmonton Geological Society. 5817

Koenig, James B. *See* . Strand, Rudolph G. 5978

5624 **Konnerth, A.** Tilly bones: Oceanus, v. 12, no. 2, p. 6–9, illus., 1966.

Curious swollen bones found in fossil deposits and in kitchen middens appear in the skeleton of some fishes. Technically known as hyperostoses, they are called "Tilly Bones" in honor of Dr. Tilly Edinger of Harvard. Paleontologists are interested in identifying the original fish to complete knowledge of animals of a particular region and period, and to establish evolutionary lines to recent fishes, as well as possible evidence of climate and ecology. To identify the bones it is essential to have a good collection of fish skeletons. That the hyperostoses arise through an aging process more often than by disease is shown by the fact that older specimens of certain species always have swollen bone parts. The bones are found in salt water around the world, more commonly in warmer areas.—G.D.C.

5674 **Kunze, G. W.** Pretreatment for mineralogical analysis, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 568–577, 1965.

The pretreatment discussed involves removing several constituents. Under removal of soluble salts and carbonates, a test for gypsum and soluble salts is given and methods for their dissolution using magnesium chloride or sodium acetate described. Removal of organic matter, using hydrogen peroxide, and removal of free iron oxides are discussed.—E.S.L.

Kunze, G. W. *See* Swoboda, A. R. 5968

5979 **LaFleur, Robert G.** Glacial geology of the Troy, N. Y. quadrangle: New York State Mus. and Sci. Service Map and Chart Ser., no. 7, 22 p., illus., geol. map, 1965.

Glacial deposits of probable Cary age exposed within the Troy, N. Y., 15-minute quadrangle are mapped in detail at a scale of 1:48,000. Successive phases of ice margin withdrawal northward across the area are described and diagrammed. Phases of development of glacial Lake Albany are recognized by shore features which include early-phase ice-contact terraces and kame deltas, a beach representing a middle-phase ice-free lake, and late-phase terraces and minor beaches associated with falling water levels. Correlations between late Lake Albany phases and early Lake Vermont phases are proposed.—Author's abstract

5774 **Lajoie, J.; Lespérance, P. J.; Béland, J.** Silurian stratigraphy and paleogeography of the Matapedia-Temiscouata region, Québec: Maritime Sediments, v. 2, no. 2, p. 73-75, illus., 1966.

The area lies in the Appalachian province, southwest of the Gaspé Peninsula. Silurian rocks overlie the Cambrian-Ordovician with angular unconformity, and are predominantly terrigenous. Basal strata vary in composition from place to place, and rocks of the Wenlock Series, transgressive from east to west, are restricted to the eastern part of the area. Ludlow and Skala age rocks occur in the southwest. All formations are described briefly, and a table is included.—E.S.L.

Lakin, H. W. *See* Lovering, T. G. 5945

Lane, William H. *See* Hart, Thomas. 5704

5801 **Lanning, F. C.; Twiss, Page C.** Vertical variations in the chemical compositionn of the Cottonwood Limestone bed in Riley County, Kansas: Kansas Acad. Sci. Trans., v. 68, no. 3, p. 438-442, illus., tables, 1965.

Vertical variations in the chemical composition of the Cottonwood Limestone Member of the Permian Beattie Formation in the Manhattan area were determined. Five samples were taken about 1 1/2 feet apart vertically, from each of four locations. The percent CaO ignition loss, acetic acid insoluble residue, MgO, Mn, and K_2O content are tabulated. There are distinct differences between the upper and lower parts of the limestone, which may be related to the fact that different fossils occur in these parts.—E.S.L.

5590 **Larson, Edwin Eric.** The structure, stratigraphy, and paleomagnetics of the Plush area, southeastern Lake County, Oregon [abs.]: Dissert. Abs., v. 26, no. 11, p. 6646, 1966.

5927 **Larson, Lawrence T.** Mineral resources summary of the Henrietta quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 5 p., 1966.

This accompanying text to Tennessee Div. Geology Geol. Map GM 304-NW by O. T. Marsh and R. E. Lounsbury (cited separately) describes the limestone resources in the Henrietta quadrangle. Exposed limestone formations include the Warsaw and the St. Louis Limestones, both of which have been quarried. The Warsaw overlies and is gradational with the Fort Payne Formation and underlies and grades into the St. Louis; its maximum exposed thickness is 130 feet. Maximum preserved thickness of the St. Louis is about 180 feet.—M.C.M.

5813 **Lee, I. K.** Stress-dilatancy performance of feldspar: Am. Soc. Civil Engineers Proc., v. 92, paper 4734, Jour. Soil Mechanics and Found. Div., no. SM2, p. 79-103, illus., tables, 1966.

The experimental work described herein is intended to extend the range of stress-strain data to a soil with an extreme value of interparticle friction angle, comparing results with the theoretical predications of Rowe's stress-dilatancy theory (1964). Feldspar was chosen because its friction angle is of the order of 37° as compared with 26° for quartz. In the natural state, the syenite feldspar used was composed of 60 percent microcline and 40 percent plagioclase. Necessary crushing of the aggregate reduced rotund forms to plate-like particles, casting some doubt on the accuracy of the basic equation, not detectable in the early stages of the test. In the case of the feldspar, no difference was apparent until the stress ratio exceeded 5.5. Samples deformed relatively uniformly with base drainage only; the stress-

dilatancy plot showed only second order variations between extreme deformation patterns.—G.D.C.

5963 **Leech, Alice Payne.** Potassium–argon dates of basic intrusive rocks of the District of Mackenzie, N.W.T.: Canadian Jour. Earth Sci., v. 3, no. 3, p. 389–412, illus., tables, 1966.

Samples were taken from diabase dikes and related contact rocks and from a differentiated intrusive body in the Yellowknife–Prosperous Lake, Lac de Gras, Point Lake, and Tree River–Coronation Gulf areas. Several samples from basic intrusions in Ontario are included. Dating by the K–Ar method indicated at least four periods of dike intrusion, 2,200–2,400, 1,900–2,100, 1,100–1,200, and 600–700 m.y. ago. Chemical and petrologic studies were carried out in conjunction with the dating. There is some suggestion of an increase in the potassium content of diabase dikes in the Canadian Shield throughout Precambrian time. Alkali–silica ratios show that all the dikes studied belong to the worldwide tholeiitic magma type.—E.S.L.

Lehmbeck, W. L. *See* Mallory, W. W. 5628

Leong, Kam Wo. *See* Hinkle, Margaret. 5944

5873 **Leow, J. H.** Reflectivity measurements on molybdenite: Econ. Geology, v. 61, no. 3, p. 598–612, illus., tables, 1966.

The spectral reflectivity of molybdenite was measured on an unpolished cleavage flake, a polished vertical section, and a polished basal section, both in air and in oil. . . . From these measurements the refractive index and the absorption were calculated. Reflectivity peaks were found at 625 nm in air measurements and at 620 nm in oil measurements. . . . Errors in reflectivity measurements made with a polarizing incident-light microscope were also considered. It was found that incremental (positive) errors are in general much higher than decremental (negative) errors.—Author's abstract

Lespérance, P. J. *See* Lajoie, J. 5774

5850 **Leveson, David J.** Orbicular rocks—A review: Geol. Soc. America Bull., v. 77, no. 4, p. 409–426, illus., tables, 1966.

Orbicular rocks are found in igneous, metamorphic, and migmatitic terrains and have been described from more than 100 localities. Orbicular structure, which is composed of concentric shells of contrasted texture and mineralogy about a central core, may have radially or tangentially oriented minerals. Spacing of orbicule shells reflects stability of the formational environment, and may result from exchange of material between core and matrix. Conditions that cause rhythmic layering in igneous rocks may result in orbicule formation if crystallization is localized about scattered centers. No correlation has been demonstrated between orbicule structure, chemical composition, or gross geologic setting. Hypotheses of orbicule genesis include both magmatic and metamorphic origins, but no single hypothesis accounts for all features represented.—H.C.D.

5972 **Levin, F. K.; Bayhi, J. F.; Grieves, W. A.; Watson, R. J.; Webster, G. M.** Developments in exploration geophysics, 1962–1965: Geophysics, v. 31, no. 2, p. 320–325, 1966.

Digital techniques are revolutionizing various phases of exploration geophysics; analysis using optical diffraction has also found considerable favor. Several new nondynamite seismic sources have been developed for land use, while in marine exploration apparatus permitting penetrations up to 8,000 feet has been developed. Common reflection point record stacking methods are used on about 75 percent of seismic field crews. Interest continues in development of mobile magnetometers of increased sensitivity, and shipborne gravity meters are being used increasingly. A system for logging up to 11 curves from separate surveys of wells on a single tape is under development. Analog computers at the well produce curves for visual

interpretation that emphasize hydrocarbon anomalies. The neutron lifetime logging system promises to locate oil behind pipe.—D.B.V.

Levin, Harold L. *See* Echols, Dorothy J. 5539

5825 **Liddicoat, Richard T., Jr.** Handbook of gem identification (7th edition): Los Angeles, Calif., Gemolog. Inst. America, 426 p., illus., tables, 1966; originally published 1947.

This book is primarily devoted to tests and procedures for identification of gemstones. Opening chapters discuss important properties of gemstones, manufactured stones, and instruments used in testing properties. Tables of properties, a glossary, and various flow charts are included.—G.D.C.

5700 **Ligon, J. David.** A Pleistocene avifauna from Haile, Florida: Florida State Mus. Bull. Biol. Sci., v. 10, no. 4, 158 p., illus., tables, 1965.

This newly discovered fauna, representing the Rancholabrean stage of the Pleistocene, has a great concentration of small vertebrates probably due to predatory birds. The avifauna of 72 species, 12 of which are extinct, represents 12 orders and 26 families. Five living species are new to the fossil record, and four others are new to the Pleistocene of Florida. Systematic descriptions are included, and evolutionary aspects and paleoecology discussed.—E.S.L.

Lin, C.-S. *See* Wood, R. V., Jr. 5680

5719 **Lofgren, Ben E.** Land subsidence due to artesian-head decline in the San Joaquin Valley, California, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 140–142, illus., 1965.

In the San Joaquin Valley, subsidence due to accelerated pumping of confined aquifers has ranged from 1 to 20 feet. In the west-central part large wells drilled to depths of 1,000 to 3,000 feet have drawn artesian water levels down as much as 400 feet since 1940. The aquifer consists of an upper unit of alluvial deposits, 400 to 800 feet thick; a middle unit of relatively impervious diatomaceous lacustrine clay, 20 to 120 feet thick; and a lower unit of lacustrine silt, clay, and sand, 600 to 2,000 feet thick, from which probably 80 percent of the ground water is pumped. Reduction in artesian head causes more stress from the overburden load to compact the deposits, with resulting subsidence of land surface. Records show 1-ft of subsidence for each 10 feet of decline of artesian head.—G.D.C.

5929 **Lofgren, Ben E.** Tectonic movement in the Grapevine area, Kern County, California, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B6–B11, illus., 1966.

Tectonic movements during the destructive Arvin–Tehachapi earthquake of 1952 caused a differential uplift of as much as two feet in the Tehachapi Mountains south of Wheeler Ridge. Periodic releveling since 1952 indicates an axis of continuing flexure two mi south of Grapevine, at the northern edge of the Tehachapi Mountains. Differential movement of bench marks during the period 1953–62 was 0.32 ft, about seven times the maximum allowable surveying error. It is not known, however, whether the axis area is rising or the areas north and south of the axis are subsiding. In either case, tectonic movement in the mountains evidently is continuing.—Author's abstract

5591 **Logan, John Merle.** Structure and petrology of the eastern margin of the Wet Mountains, Colorado [abs.]: Dissert. Abs., v. 26, no. 11, p. 6646–6647, 1966.

5967 **Loncarevic, B. D.; Mason, C. S.; Matthews, D. H.** Mid-Atlantic ridge near 45° North—[Pt.] 1, The median valley: Canadian Jour. Earth Sci., v. 3, no. 3, p. 327–349, illus., 1966.

Detailed maps of bathymetry, free air gravity anomaly, and total field magnetic anomaly are presented for an area approximately 50×20 mi along the crest of the

ridge. The median valley and the associated belt of large positive magnetic anomalies are continuous and display a striking lineation. The free air gravity anomaly shows a strong resemblance to topography. This correlation disappears when the Bouguer anomaly is calculated, indicating that the intrusive body underlying median valley is not different in density from those beneath elongated seamounts overlooking the valley. A two dimensional model in which steeply dipping contacts separate blocks of rocks having different magnetization will fit the magnetic anomalies. The mechanism by which the valley was formed is still obscure.—*from* Authors' abstract

Lounsbury, Richard E. *See* Marsh, Owen T. 5923

Lounsbury, Richard E. *See* Barnes, Robert H. 5926

5945 **Lovering, T. G.; Lakin, H. W.; McCarthy, J. H.** Tellurium and mercury in jasperoid samples, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B138-B141, table, 1966.

Ninety-three samples of jasperoid from 22 areas, including 14 mining districts, were analyzed for tellurium and mercury by new methods capable of detecting 0.1 ppm of tellurium (by precipitation of gold in H Cl) and 0.01 ppm of mercury (by atomic absorption). These samples had been analyzed spectrographically for minor elements and classified on the basis of their field relations, composition, and other characteristics as either "favorable type" (commonly associated with metalliferous ore), or "unfavorable type" (not commonly associated with ore). Tellurium content of these samples ranges from 200 to<0.1 ppm, mercury content from 90 to 0.02 ppm.... Tellurium content of >1 ppm and mercury content of >5 ppm are found to be characteristic of jasperoid of the favorable type.—Authors' abstract

Lowman, F. G. *See* Miro, M. 5722

5606 **Lowry, Marlin E.; Cummings, T. Ray.** Ground-water resources of Sheridan County, Wyoming: U.S. Geol. Survey Water-Supply Paper 1807, 77 p., illus., tables, geol. map, 1966.

Pre-Tertiary aquifers that might yield large supplies of water include Bighorn Dolomite, Madison Limestone, Amsden Formation, and Tensleep Sandstone. The few wells which tap these aquifers are restricted to outcrop areas. Adequate supplies of ground water for stock or domestic use can be developed from the Tertiary Fort Union and Wasatch Formations; however, locally, quality varies greatly. Quaternary deposits generally yield small to moderate supplies of water to wells; usable supplies can be developed principally along valleys of perennial streams and can be used as stock supply but is objectionable for domestic and irrigation use.—*from* Authors' abstract

Lukens, H. R., Jr. *See* Guinn, V. P. 5954

5556 **Lusczynski, N. J.; Swarzenski, W. V.** Salt-water encroachment in southern Nassau and southeastern Queens Counties, Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1613-F, p. F1-F76, illus., tables, 1966.

Salty ground water occurs in southern Nassau and southeastern Queens Counties as three wedgelike extensions projecting landward in unconsolidated deposits from a main body of salty water lying seaward of barrier beaches and Jamaica Bay in permeable and shallow and deep clay deposits. Shallow salty water in Pleistocene and Recent deposits is connected freely with bays, tidal estuaries, and ocean. Zones of diffusion up to 6 miles wide and about 500 feet thick were delineated in salty-water wedge fronts. The intermediate wedge has moved less than 1,000 feet since 1900, and the deep wedge as much as a mile locally, but less than 1,000 feet regionally. Along and near barrier beaches, salty water from underside of the deep wedge in clay of the Raritan Formation is moving downward slowly toward fresh water in the Lloyd Sand Member. It is esimated that no serious [well] contamination will occur for at least 20 years.—*from* Authors' abstract

Lydon, P. A. *See* O'Brien, J. C. 5847

5989 **Lynn, D. C.; Bonatti, E.** Mobility of manganese in diagenesis of deep-sea sediments: Marine Geology, v. 3, no. 6, p. 457–474, illus., 1965.

Studies of deep-sea sediment cores from the Pacific indicate that manganese, found at the tops, dissolves upon burial in reduced sediments, slowly migrates by ionic or molecular diffusion in the pore solution, and then accumulates in the oxidized top strata. Thickness of the manganese layer increases seaward, and reduced strata may lie under a relatively thick oxidized layer in pelagic regions. It is concluded that manganese migrating from reduced sediment may in some cases form oxide concretions at the surface of a deposit; the currently accepted average amount of manganese in pelagic deposits may not be representative of manganese content in the entire sediment column but may be an overestimate; and post-depositional migration mechanisms such as this probably modify the vertical distribution of several other elements associated with the manganese-oxide phases.—V.S.N.

5997 **Mabey, Don R.** Relation between Bouguer gravity anomalies and regional topography in Nevada and the eastern Snake River Plain, Idaho, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B108–B110, illus., tables, 1966.

An analysis of the relation between Bouguer gravity-anomaly values and regional elevation for 57 gravity stations in Nevada indicates that the Bouguer anomaly value for stations not affected by low-density Cenozoic rocks is approximately equal to 3 mgals plus −0.032 mgal per ft multiplied by the average elevation within 64 km of the station. The analysis of local anomalies is facilitated by the removal of a regional variation, computed by this method, from the measured anomalies. A similar treatment appears applicable to data from the eastern Snake River Plain if 35 mgals is added to the computed anomaly value.—Author's abstract

5607 **MacCary, L. M.; Davis, R. W.** Availability of ground water in the Westplains quadrangle, Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-166, scale 1:24,000, section, text, 1966.

Most wells in the Westplains quadrangle are less than 200 feet deep and obtain ground water from Eocene sands which thicken from east to west. Present withdrawals are insignificant compared to the large amount of water in storage in the sands. A few wells in bottom-land areas obtain ground water from alluvial deposits.—M.C.M.

5635 **MacDonald, J. R.** The search for the king of the tyrant lizards: Los Angeles County Mus. Nat. Hist. Quart., v. 4, no. 3, p. 18–22, illus., 1965–66.

During a search for a mountable skeleton of *Tyrannosaurus rex* for the Los Angeles Museum in the Hell Creek Formation of Montana, a large *Triceratops* skeleton was discovered. The techniques of digging and preparation for shipment are described briefly.—G.D.C.

5636 **MacDonald, J. R.** Fossils are for digging: Los Angeles County Mus. Nat. History Quart., v. 4, no. 4, p. 37–40, illus., 1966.

In answer to the taxpayer or museum patron who asks "Why go far to get your fossils?", this short article explains the need for the right kind of fossils for interesting and educational exhibits, as well as the problems of finding, excavating, and mounting specimens, specifically bones of dinosaurs. Also mentioned are the gaps in records of geologic ages, and the missing parts of skeletal finds.—G.D.C.

5824 **Mack, Frederick K.** Ground water in Prince Georges County: Maryland Geol. Survey Bull. 29, 101 p., illus., tables, 1966.

Prince Georges County is underlain by a wedge-shaped mass of unconsolidated Coastal Plain (Cretaceous-Quaternary) sediments overlying older crystalline rocks; from northwest to southeast the wedge varies from less than a ft thick to 2,500–3,000 feet. Major aquifers—Patuxent, Patapsco, Magothy, and Aquia Formations—dip gently southeast. Of the 44 mgd used in 1963, about 25 percent was from ground-water sources. Artesian aquifers function as reservoirs and conduits;

quantities of water stored in them are adequate to supply water far into the future at current usage rates. Waterbearing properties of the major formations, most favorable in the northeast, become progressively less so toward the southwest. Water from the northern area generally needs treatment for high iron and low pH. Possibility of salt-water contamination is confined to a small area adjacent to the lower Patuxent River.—*from* Author's abstract

5737 **MacKallor, Jules A.** Aeroradioactivity survey and geology of Puerto Rico (ARMS-I): U.S. Atomic Energy Comm. Civil Effects Study CEX-61.7.2, 24 p., illus., geol. map, 1966.

Radioactivity of Puerto Rico ranges between 50 and 800 cps with more than three-fourths of the island at 300 cps or less. Geology and radioactivity of the 14 geologic units are discussed briefly. Most units have radioactivity of only a few hundred cps, but some limestone areas are as high as 800 cps. Utuado pluton's granodiorite core has a radioactivity high of 300–600 cps in contrast to 200–300 cps of quartz diorite and surrounding rocks. San Lorenzo batholith's granodiorite has radioactivity of 200–400 cps with 100–200 cps in surrounding rocks. An area of 50–100 cps in southwest Puerto Rico correlated with a body of serpentinite.—*from* Author's abstract

6021 **MacKevett, E. M., Jr.; Radtke, A. S.** Hydrothermal alteration near the Kennecott copper mines, Wrangell Mountains area, Alaska—A preliminary report, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B165-B168, illus., table, 1966.

Hydrothermal alteration near the Kennecott mines in Alaska consists of an early dolomitic phase and a later jarosite-illite-potassium feldspar phase that has been recognized only recently. The dolomitic alteration is widespread throughout the lower part of the Chitistone Limestone, the host for the Kennecott copper deposits. The jarosite-illite-potassium feldspar alteration is less extensive and is largely confined to the vicinity of known ore deposits; it is characterized by light-brown zones of jarosite, illite, potassium feldspar, and montmorillonite that are best developed near the contact between the Nikolai Greenstone and the Chitistone Limestone, especially in the area between the Erie and Jumbo mines.—Authors' abstract

MacNeil, F. S. *See* Plafker, George. 6016

5776 **MacNeill, R. H.** Variation in content of some drumlins and tills in southwestern Nova Scotia: Maritime Sediments, v. 1, no. 3, p. 16–19, illus., 1965.

A white-gray rock flour type of drift is described and contrasted with a reddish-brown high-clay type containing particles and rocks. Both are highly compacted but the former breaks up more easily. In many instances two distinct types are found in the same spot.—E.S.L.

5942 **Madsen, Beth M.** Loeweite, vanthoffite, bloedite, and leonite from southeastern New Mexico, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B125-B129, illus., tables, 1966.

Optical data, chemical analyses, and X-ray powder data are given for four uncommon sulfate minerals: loeweite, vanthoffite, bloedite, and leonite. The minerals occur in a marine evaporite, the Salado Formation of Permian age. This is the first report of loeweite in the United States.—Author's abstract

Maienthal, E. June. *See* Taylor, John K. 5955

5794 **Maine, Charles H.** Micro-drainage ways, *in* Anatomy of a watershed, Red Cedar River, Michigan: East Lansing, Mich., Michigan State Univ., Dept. Resource Devel., p. 121–130, illus. [1966].

A 240-acre area of cropland and a 55-acre plot of woodland in the Red Cedar watershed were selected for mapping. More prominent features were noted, and the drainage system was traced from mouth to source, using a hand level when

necessary. One permanent stream and two intermittent, several potholes, and a manmade pond were mapped in the cropland. In the woodland, no permanent stream and only one intermittent are present. Potholes are also mapped. Lines representing the paths water will follow when flowing off the land are included. The process of erosion and value of maps showing microdrainage are discussed.—E.S.L.

5628 **Mallory, W. W.; Post, E. V.; Ruane, P. J.; Lehmbeck, W. L.; Stotelmeyer, R. B.** Mineral resources of the Flat Tops primitive area, Colorado: U.S. Geol. Survey Bull. 1230-C, p. C1-C30, illus., tables, geol. map, 1966.

South Fork area of Flat Tops, part of a large structural dome of Precambrian crystalline rocks with a thin cover of Paleozoic sedimentary rocks, is capped by extensive basalt flows forming a broad plateau; in the Pyramid area, remnants of basalt flows form high peaks and steep ridges. This primitive area is about 50 mi northwest of the mineral deposit belt that has produced most of Colorado's mineral wealth. Colorado basalt of the kind forming the extensive caprock of the area is generally barren of mineral deposits; in contrast the Leadville Limestone, below the basalt over a wide area, is an especially favorable host rock for mineral deposits. Analyses of stream and soil samples revealed a few anomalous areas which were thoroughly investigated. No mineral deposits of commercial importance are known.—*from* Authors' abstract

5930 **Mallory, W. W.** Cattle Creek anticline, a salt diapir near Glenwood Springs, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B12-B15, illus., 1966.

The Cattle Creek anticline, seven mi south of Glenwood Springs, Garfield County, Colo., is determined by vertical dip in gypsum of the Eagle Valley Evaporite on the west side of the Roaring Fork Valley and by gentle dip in the Maroon Formation on the east side. A well 3,060 feet deep near the axis of the structure penetrates a thick section of gypsum, anhydrite, and halite probably older than beds exposed at the surface. Presence of an isolated arch of halite only 2,100 feet below the surface in a strongly expressed anticline indicates diapiric structure. Potash and oil or gas may be present at depth.—Author's abstract

Marinenko, George. *See* Taylor, John K. 5955

5791 **Marovelli, R. L.; Chen, T. S.; Veith, K. F.** Thermal fragmentation of rock: Soc. Mining Engineers Trans., v. 235, no. 1, p. 1-15, illus., table, 1966.

An analytical study is reported of thermal stress distribution in circular discs of basalt, quartzite, taconite. Samples were subjected to peripheral thermal shock at various rates of heat transfer. The study was primarily to predict the thermal shock response of a rock body of finite size for the application of thermal methods of rock fragmentation in mining. An average stress theory is formulated from solutions of stress distribution in both cooling and heating shocks. Physical properties used in the analysis—Young's modulus, tensile strength, coefficient of linear thermal expansion, thermal diffusivity and conductivity—are plotted.—V.S.N.

5922 **Marsh, Owen T.** Geologic map of the Slayden quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 302-SW, scale 1:24,000, separate text, 1966.

The text, "Mineral resources summary of the Slayden quadrangle, Tennessee" by R. E. Hershey, is cited separately.—M.C.M.

5923 **Marsh, Owen T.; Lounsbury, Richard E.** Geologic map of the Henrietta quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 304-NW, scale 1:24,000, separate text, 1966.

The text, "Mineral resources summary of the Henrietta quadrangle, Tennessee" by L. T. Larson, is cited separately.—M.C.M.

5787 **Martin, James A.; Wells, Jack S.** Guidebook to Middle Ordovician and Mississippian strata, St. Louis and St. Charles Counties, Missouri—Am. Assoc.

Petroleum Geologists, 1966 Ann. Mtg.: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 34, 48 p., illus., 1966.

The guidebook includes two technical papers, east–west and north–south cross sections, and a road log which includes sections of the various formations to be seen.—E.S.L.

5592 **Martini, Jose Alberto.** Chemical, mineralogical and physical properties of seven surface soils from Panama with special reference to cation exchange capacity and potassium status [abs.]: Dissert. Abs., v. 26, no. 11, p. 6647, 1966.

Martinson, R. M. *See* Wood, R. V., Jr. 5680

5907 **Mason, Brian.** Geochemistry and meteorites: Geochim. et Cosmochim. Acta, v. 30, no. 4, p. 365–374, tables, 1966.

Goldschmidt's (1923) geochemical classification of the elements into siderophile, chalcophile, lithophile, and atmophile groups is reviewed, and its pertinence to meteorites is emphasized. The occurrence and distribution of Ni, Mg, Si, P, Ca, Ti, Va, Cr, Mn, Fe, Ni, and Cu in meteorites are discussed. The normally lithophile Ca, Ti, Cr, and Mn become chalcophile in meteorites showing a very high degree of reduction (enstatite chondrites and enstatite achondrites).—D.B.V.

Mason, C. S. *See* Loncarevic, B. D. 5967

Massalski, Tadeusz B. *See* Park, Frederick R. 5901

Matthews, D. H. *See* Loncarevic, B. D. 5967

5819 **Maurer, Robert E.** Review of the coal deposits of eastern Sevier County, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 15, 24 p., illus., tables, geol. map, 1966.

Coal deposits of potential economic value occur in the Salina Canyon district, the Wasatch Plateau field and the Castle Valley field in eastern Sevier County. The coal occurs in several different beds distributed in the Upper Cretaceous Ferron Sandstone and Blackhawk Formation. Analyses indicate heat values and other characteristics of coal in the high volatile C and B bituminous range. Total production of coal from eastern Sevier County has been less than 0.1 percent of the estimated reserves of 2,197,331,000 short tons.—Author's abstract

McCarthy, J. H. *See* Lovering, T. G. 5945

McCauley, Camilla K. *See* Butler, James Robert. 5626

5765 **McCauley, Marvin L.** The use of sub-audible rock noise (SARN) recordings to monitor slope stability: Eng. Geology, v. 2, no. 2, p. 1–8, illus., 1965.

The Materials and Research Dept. of the California Div. of Highways is evaluating the use of sub-audible rock noise, SARN, to monitor slopes, using the highway construction around the San Luis Reservoir as a test area. SARN records were taken at three sites, for cuts, during construction and through the winter rainy season. The SARN rates were high during construction, then decreased, increased again during the rainy season and decreased during the dry season. No major slides occurred at any of the locations, but small local failures appear to be reflected in the SARN records. Simultaneous recordings from two adjacent probes will be used in future work.—E.S.L.

5812 **McCracken, Mary H.** The structural features of St. Louis County and vicinity, *in* Guidebook to Middle Ordovician and Mississippian strata, . . . —Am. Assoc. Petroleum Geologists, 1966 Ann. Mtg.: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 34, p. 38–41, illus., 1966.

The area is part of a monoclinal structure, dipping northeast at a rate of about 55 feet per mi. The monocline is interrupted by several transverse anticlinal and

synclinal structures; the most important folds are the Eureka–House Springs and Dupo–Waterloo anticlines, which may be related to basement faulting. The Dupo–Waterloo–Florissant trend is terminated by the Cap au Gres fault. It seems possible that this is a left-lateral fault offsetting the Lincoln fold from the Dupo–Waterloo by about 30 miles.—E.S.L.

5759 **McCrone, A. W.** Thixotropy and the mobilization of clays in slumps and turbidity flows: Jour. Sed. Petrology, v. 36, no. 1, p. 270, 1966.

Mobilization of clays in earthquake-triggered slumps and turbidity currents may be attributable to the thixotropic properties of the clays as well as to ordinary physical dislodgement.—H.A.T.

5665 **McCutchen, William T.** Set theory and rock classifications: Jour. Geol. Education, v. 14, no. 3, p. 91–92, illus., 1966.

A set is a group of items (elements) possessing one or more common characteristic properties. Subsets are recognized by restrictive properties and have intersecting boundaries. The intersections contain polygenetic types. Examples are given for a wacke and a sedimentary rock set, with Venn diagrams. Set theory and Venn diagrams are used best in the introduction to rock classification.—E.S.L.

McDonald, W. G. *See* Sutton, G. H. 5654

McIntyre, D. B. *See* Baird, A. K. 5730

McKenzie, G. D. *See* Dreimanis, A. 5966

5988 **McManus, Dean A.** Blanco fracture zone, northeast Pacific Ocean: Marine Geology, v. 3, no. 6, p. 429–455, illus., 1965.

Blanco fracture zone in the northeast Pacific is the shortest so far discovered and converges with the Mendocino zone from the north at an angle of 30–50°. Associated bottom topography suggests a transcurrent fault zone with left-lateral offset of 275 km in contrast to the 110 km right-lateral offset estimated from magnetic anomalies in the area. The Blanco zone is interpreted to be one of the northwest-trending Miocene structures in this area. Future studies, however, may show it to be an en echelon arrangement of east–west faults. The seismic activity associated with the zone can be interpreted as representing the intersection of this zone and the crest of the northern extension of the East Pacific Rise; other possible explanations are discussed. A bathymetric chart of the ocean floor off the northwestern United States and one of earthquake epicenters are included.—V.S.N.

5583 **Medaris, Levi Gordon, Jr.** Geology of the Seiad Valley area, Siskiyou County, California, and petrology of the Seiad ultramafic complex [abs.]: Dissert. Abs., v. 26, no. 10, p. 5977, 1966.

Mensik, J. D. *See* Huffman, Claude, Jr. 5904

5659 **Menzel, Ronald G.** Elemental analysis by polarography, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 879–890, illus., 1965.

Two procedures are presented—the simultaneous determination of several elements in soil digests or extracts, and the determination of dissolved oxygen, illustrating continuous determination of one component of the soil solution. Instrumentation, sample preparation, and calibration are discussed, and working principles given.—E.S.L.

5605 **Mesnier, Glennon N.; Chase, Edith Becker.** (compilers). Selected techniques in water resources investigations, 1965: U.S. Geol. Survey Water-Supply Paper 1822, 117 p., illus., tables, 1966.

The present report contains 25 papers that represent new ideas being tested or applied in the hydrologic field program of the Geological Survey since publication

of a similar report in 1963. These ideas range from a proposed system for monitoring fluvial sediment to how to construct stream-gaging wells from steel oil drums. The original papers have been revised and edited by the compilers, but the ideas presented are those of the authors. Papers by H. P. Guy, J. R. George and J. W. Wark, R. J. Pickering, and P. R. Seaber and J. Vecchioli are cited separately.—M.C.M.

5763 **Mesolella, Kenneth J.** Collophane associated with the unconformity at the base of the Devonian Onondaga Limestone in New York State: Jour. Sed. Petrology, v. 36, no. 1, p. 260–262, illus., 1966.

Collophane in nodules, ovules, and cement is associated with the unconformity at the base of the Onondaga Limestone in New York State. Oolites and some nodules were mechanically concentrated. Other nodules and cemented masses were formed chemically after deposition.—H.A.T.

5602 **Meuschke, J. L.; Pitkin, J. A.; Smith, C. W.** Aeromagnetic map of Sacramento and vicinity, California: U.S. Geol. Survey Geophys. Inv. Map GP-574, scale 1:250,000, 1966.

6012 **Meyboom, P.** Unsteady groundwater flow near a willow ring in hummocky moraine: Jour. Hydrology, v. 4, no. 1, p. 38–62, illus., tables, 1966.

Three types of ground-water flow are associated with a ring of willows in south-central Saskatchewan: a winter condition of normal downward flow, a spring condition characterized by a ground-water mound under the enclosed slough with an associated lateral and vertical dissipation flow pattern, and a condition of inverted water-table relief existing during summer and fall owing to a cone of depression around the phreatophytes. A water balance showed that the overall effect was a net contribution to the regional resources of 2.9 cu ft.—E.S.L.

5781 **Meyer, W. C.; Fay, C. B.** (compilers). Selected bibliography on Canadian geography: Canada Dept. Mines and Tech. Surveys Geog. Br. Bibliog. Ser. 33, 106 p., 1965.

The first part of the bibliography lists books and periodicals, according to subject under Canada and then divided into the provinces of eastern and western Canada, methodology, and research. Maps and charts are treated similarly for Canada, eastern and western Canada, and for each province. Imprint date for maps and publications is 1963.—M.C.M.

Mifflin, Martin. *See* Morrison, Roger B. 5710

Mifflin, Martin. *See* Morrison, Roger B. 5712

5858 **Mifflin, Martin.** Hydrology of the Lahontan Basin, northwestern Nevada, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 25–28, illus., 1965.

The Lahontan Basin is watered by four major rivers which lose themselves in sinks or small lakes in the interior of the basin. The antecedent Truckee, Carson, and Walker Rivers head on the east slope of the Sierra Nevada and cross at least one basin range before termination. The Humboldt River, about 400 mi long, flows westerly from the extensively glaciated Ruby-East Humboldt Range. Its alluviated valleys are underlain by well-sorted deltaic gravel as much as 150 feet thick, intercalated with fine-grained Pleistocene lake sediments, into which it has cut terraces so that modern alluvium is in contact with deltaic gravels, allowing rapid infiltration of river water into ground-water aquifer. It has been estimated that in the Battle Mountain and Winnemucca areas, as much as 700,000 acre feet of underground water storage may be possible.—G.D.C.

Migliaccio, Ralph R. *See* Coulter, Henry W. 5687

5584 **Miles, Charles Hammond.** Metamorphism and hydrothermal alteration in the Lecheguilla Peak area of the Rincon Mountains, Cochise County, Arizona [abs.]: Dissert. Abs., v. 26, no. 10, p. 5977–5978, 1966.

5886 **Miller, Frederick Powell.** Physical, chemical, and mineralogical properties related to the micromorphology of the Canfield silt loam—A Fragiudalf [abs.]: Dissert. Abs., v. 26, no. 11, p. 6273, 1966.

5925 **Miller, Robert A.** Mineral resources summary of the Lawrenceburg quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 6 p., table, 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 52–NE by R. H. Barnes (cited separately), and describes the chert and limestone resources in the Lawrenceburg quadrangle. Eighteen chert pits have been excavated throughout the area and seven are active. Most of the area is underlain by cherty Mississippian formations, principally the Fort Payne Formation, and to a lesser extent, the overlying Warsaw Limestone. The Fort Payne is desirable for general chert uses because of consistency of fragment size and binding ability. Two abandoned limestone quarries in the Fort Payne Formation are present in the quadrangle; a potential resource is gravel.—M.C.M.

Mills, J. W. *See* Rosenberg, P. E. 5650

5931 **Minard, James P.; Owens, James P.** Domes in the Atlantic Coastal Plain east of Trenton, New Jersey, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–B, p. B16–B19, illus., 1966.

The presence of two elongate domes in the coastal-plain formations east of Trenton, N. J., has been established by detailed mapping. They were delineated by plotting the tops of two formations of Late Cretaceous age as determined in 85 outcrops and auger holes. Formations as young as Miocene seem to be involved in the folding. Other similar structures or folds may be present along the inner edge of the coastal plain in the area. Such structures may be suitable for underground gas storage.—Authors' abstract

5937 **Minard, James P.** Sandblasted blocks on a hill in the coastal plain of New Jersey, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–B, p. B87–B90, illus., 1966.

Sandblasted blocks from an indurated layer in the Beacon Hill Gravel are present on a hill in the north-central part of the Atlantic Coastal Plain in New Jersey. The blocks have pitted ends and fluted, faceted, and polished surfaces, thought to have been cut during the Wisconsin Glaciation when strong winds from a continental ice sheet blew over a sandy surface devoid of vegetation. The climate probably was similar to that now prevailing in northern Greenland.—Author's abstract

5722 **Miro, M.; dePadovani, I. Oliver; Ramos, E.; Román de Vega, V.; Lowman, F. G.** The determination of stable scandium in plants, animals, sediments, sands, soils, rocks and minerals by neutron-activation analysis: Anal. Chim. Acta, v. 35, no. 1, p. 54–60, table, 1966.

A method, much more sensitive and precise than optical spectrographic and colorimetric methods, is described for determination of stable scandium in samples of the above materials. The samples and comparator standards were irradiated in a neutron flux of $5 \cdot 10^{12}$ n/cm^2/sec for 4 h and dissolved, and the scandium quantitatively precipitated from 2 *N* nitric acid as scandium phytate; contaminants were rinsed from the precipitate with nitric and hydrochloric acids. The limit of detection was 0.005 μg (10 percent at the 95 percent confidence level). The activated Sc–46 was counted by γ-spectrometry.—G.D.C.

5603 **Mitchell, C. M.; Vargo, J. L.** Aeromagnetic map of Hopi Buttes and vicinity, Navajo County, Arizona: U.S. Geol. Survey Geophys. Inv. Map GP–575, scale 1:125,000, 1966.

5862 **Mogi, Kiyoo.** Some precise measurements of fracture strength of rocks under uniform compressive stress [with German and French abs.]: Felsmechanik u. Ingenieurgeologie, v. 4, no. 1, p. 41–55, illus., tables, 1966.

An improved sample design is presented for rock compression tests which combines the better features of Brace's (1964) design with greater ease of fabrication. The specimen is a long right cylinder (granite, dolomite, and porous trachyte used in tests) connected to steel end pieces by epoxy. The thickness of the epoxy is gradually decreased from the steel end pieces toward the middle of the specimen which probably eliminates most of the stress concentration at the contact of rock with steel. The pressure dependence of strength and fracture angle was determined for the granite and dolomite, and it is shown that the fracture angle as predicted by the Mohr theory is within a few degrees of the observed value at all pressures. All fractures tested with this design are inclined to maximum compression by large amounts; no vertical cracking was observed.—V.S.N.

Moiola, R. J. *See* Wermund, E. G. 5760

5734 **Mongin, Denise.** Les mollusques du miocène de la Guadeloupe, recueillis par A. de Reynal: Acad. Sci. Comptes Rendus, v. 260, no. 21, p. 5604–5605, 1965.

A Miocene age is confirmed for the molluscan fauna of Tertiary sediments of Guadeloupe. Pelecypods are the principal elements of the fauna; many of the species are known from other islands of the West Indies and also from the Miocene of Florida and the Chesapeake Bay.—M.L.S.

Moore, David G. *See* Dill, Robert F. 5868

Moore, James G. *See* Richter, Donald H. 5689

5562 **Morris, Arthur Edward.** Phase equilibria in the system MnO–Mn_2O_3–SiO_2 [abs.]: Dissert. Abs., v. 26, no. 11, p. 6633–6634, 1966.

6004 **Morrison, George H.** (editor). Trace analysis, physical methods: New York, Interscience Publishers, 582 p., illus., tables, 1965.

Compiled here are the various aspects of modern science that collectively contribute to the specialized field of trace-element analysis. Authorities in their respective fields have written the separate chapters, of which Chapters 8, 9, 10, and 11 are individually cited.—G.D.C.

5708 **Morrison, Roger B.** Salt Lake City to Little Cottonwood area and return, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 6–14, illus., 1965.

Physical evidence for contemporaneity of glacial and lake maxima in the Bonneville Basin are examined here, including interfingering of till of the Bull Lake Glaciation with lake deposits of the Alpine Formation. The route along the west base of the Wasatch Range lies just below the highest shoreline of Lake Bonneville, and also close to the main zone of Cenozoic movement of the Wasatch fault which defines the western edge of the Range for 115 mi with a vertical displacement up to 6,000 feet, most of which took place long before the first rise of Lake Bonneville. Big and Little Cottonwood Canyons, where glacial deposits are seen, head in one of the highest parts of the Wasatch Range, were cut deeply by Pleistocene glaciation, and were subsequently trenched. The sheer quartz-monzonite walls of the Little Cottonwood Canyon are over 2,000 feet high; drainage is asymmetrical and is ephemeral on the north side.—G.D.C.

5710 **Morrison, Roger B.; Mifflin, Martin; Wheat, Margaret.** Rye Patch Dam, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 28–35, illus., 1965.

This area has extensive exposures of Quaternary sediments of both Lake Lahontan and pre-Lake Lahontan age, the depth of exposure resulting from upwarping of this part of the Humboldt Valley. The uplift is partly along many small faults, several transverse to the main structural valley. Most of the faulting antedated Lake Lahontan, but immediately southeast of Rye Patch Dam sediments of the Eetza Formation are displaced a few feet. The lithofacies of the several Quaternary units are described for the localities visited, including weathering profiles and a spectacular complex of gravel beach-bars of Lake Lahontan.—G.D.C.

5711 **Morrison, Roger B.** Wave-built bars at Fallon turnoff (Eetza bar), *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 33–35, illus., 1965.

In this area 19.5 mi southwest of Lovelock, Nev., is a spectacular complex of gravel beach-bars built by waves of Lake Lahontan in Pleistocene time. It comprises an anomalous fan gravel of the Paiute Formation, and thin layers of the Lahontan Valley Group, in a series of embankments almost two miles wide at the north end which are considered by Russell (1885) to have been built by longshore currents with many intervals of erosion and rebuilding.—G.D.C.

5712 **Morrison, Roger B.; Mifflin, Martin; Wheat, Margaret.** Badland amphitheatre on Truckee River north of Wadsworth, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 38–48, illus., table, 1965.

The 200-ft bluffs near Wadsworth that ring this amphitheatre on the north and east provide one of the most complete and continuous exposures available of the Lahontan Valley Group. The main stratigraphic units are almost the same as at Rye Patch Dam. At the top, eolian sand of the Turupah and Fallon Formations form dunes as much as 30 feet high above the Sehoo Formation. The subdivisions are briefly described and illustrated by a geologic sketch map, cross section, and measured lithology.—G.D.C.

5876 **Mortensen, J. L.; Anderson, D. M.; White, J. L.** Infrared spectrometry, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 743–770, illus., tables, 1965.

Infrared spectrometry can be used to identify inorganic compounds and minerals which have well-defined absorption bands, to determine whether a layer silicate is di- or tri-octahedral, to study isomorphous substitutions, to investigate the hydration of minerals for identification of organic compounds, and for quantitative analysis. Infrared techniques provide information about the nature and identity of compounds that may be amorphous to X-rays. The mechanism and use of the infrared spectrometer are discussed. Methods for preparation of samples and tables of the characteristics of group frequencies and absorption bands found in organic and inorganic matter are given.—E.L.

Mourant, W. A. *See* Dinwiddie, G. A. 5990

5998 **Mudge, M. R.; Robinson, G. D.; Eaton, G. P.** Preliminary report on regional aeromagnetic anomalies in northwestern Montana, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B111-B114, illus., 1966.

Two large north-northwesterly trending magnetic anomalies occur on four widely spaced aeromagnetic traverses in northwestern Montana. One anomaly extends at least 60 mi along the western flanks of the Sawtooth and the Lewis and Clark Ranges. It is broad and has a gently sloping profile and a maximum amplitude of 700 gammas. A distinct gravity anomaly coincides with this magnetic anomaly. Thirty mi to the east, another magnetic anomaly extends for at least 40 mi along the western border of the High Plains. This anomaly is narrow, has a steep profile with a maximum amplitude of 1,600 gammas, and is not associated with a distinct gravity anomaly.—Authors' abstract

Mumback, N. R. *See* Flanigen, E. M. 5810

Myers, Alfred T. *See* Specht, Alston W. 5656

5934 **Myers, Donald A.** *Oketaella earglei*, a new fusulinid species, from the Adams Branch Limestone Member of the Graford Formation of Late Pennsylvanian age, Brown County, Texas, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B47-B50, illus., table, 1966.

Specimens of a new fusulinid species, *Oketaella earglei*, described in this report, were collected from the Adams Branch Limestone Member of the Graford Formation (Upper Pennsylvanian) in north-central Texas. Poorly preserved specimens of this form had been questionably referred to the genus *Staffela* by Myers in 1960.—Author's abstract

5871 **National Speleological Society.** History of the National Speleological Society: Natl. Speleol. Soc. Bull., v. 28, no. 1, p. 38-54, illus., tables, 1966.

This Society came into existence 25 years ago, with nearly 100 members. Its short-lived predecessor, the Speleological Society of the District of Columbia, established in 1939, stated in its first Bulletin plans for growth into a national organization; its object was to be a clearing house for all cave information, the accumulation of a library, and publication of a periodical organ for the science of speleology. Early excursions are recalled, the organizational structure briefly described, as well as the present publications, library, and conventions. The 88 active chapters in the United States are listed; a few joint activities include a conservation program.—G.D.C.

5783 **Neuerburg, George J.** Distribution of selected accessory minerals in the Osgood Mountains stock, Humboldt County, Nevada: U.S. Geol. Survey Misc. Geol. Inv. Map I-471, scale 1:24,000, text, 1966.

The granodiorite stock in northeastern Osgood Mountains quadrangle is intruded into complexly folded and thrust-faulted Paleozoic sedimentary rocks, elongated north-south, and consists of two lobes joined by a narrow neck. The maps show quantitatively distribution of accessory sulfides (mainly pyrite), magnetite, zircon, and gold, and locations at which chalcopyrite and molybdenite occur. Weathering probably modifies the sulfide distribution pattern, but if changes are relative, the indicated abundance pattern is a close reflection of the original; patterns of zircon, magnetite, and gold probably are not affected by weathering. Gold abundance is one to two orders of magnitude greater than that for the crust or granitic rocks; prospecting adjacent to high gold concentrations along the stock contact is indicated.—M.C.M.

5870 **Neumann, A. Conrad.** Observations on coastal erosion in Bermuda and measurements of the boring rate of the sponge, *Cliona lampa*: Limnology and Oceanography, v. 11, no. 1, p. 92-108, illus., tables, 1966.

Steep cliffs around Harrington Sound are undercut as much as 5 m by a notch whose flat roof coincides closely with the lowest level of low tides. With the resulting restriction in wave energy, *bioerosion* is proposed as the mechanism of undercutting. On the carbonate coastline of Bermuda organisms of many types alter the exposed rock surface from the upper reaches of the spray zone to depths well below sea level. Experiments show that *Cliona lampa* is capable of removing 6 to 7 kg of material from 1 sq m of carbonate substrata in 100 days, corresponding to an erosion rate of calcarenite of more than 1 cm per year. If 90 percent of this boring is mechanical and not chemical, then 5 to 6 km of fine-grained carbonate detritus can be supplied from 1 sq m of sponge-infected substrate in 100 days.—G.D.C.

Newell, M. F. *See* Stern, T. W. 5946

Newhouse, T. W. *See* Arnett, R. A. 5875

Newill, D. *See* Dumbleton, M. J. 5991

5838 **Noorany, Iraj; Seed, H. Bolton.** In-situ strength characteristics of soft clays [reply to discussion of paper 4274, 1965]: Am. Soc. Civil Engineers Proc., v. 92, Jour. Soil Mechanics and Found. Div., no. SM3, p. 93–95, 1966.

Even if the best available techniques were used for evaluating the effects of perfect sampling, disturbance, and environmental factors such as temperature, on the undrained strength of saturated clay, the corrected strength would represent the ground strength only at the particular point where strain conditions are produced. The applicability of the Hvorslev parameters may not be valid in the comparison of perfect samples and ground elements with other than the same orientations of the failure plane and principal stress axes.—G.D.C.

5857 **Northrop, Stuart A.** University of New Mexico contributions in geology, 1898–1964: New Mexico Univ. Pubs. Geology, no. 7, 152 p., 1966.

The bibliography consists of a chronological, serially numbered list of all publications by staff members and graduate students of the University of New Mexico Department of Geology, while in residence, 1898–1964. Masters' theses and doctoral dissertations are included; some are available on microcard or microfilm from the University Library. A history of the University Department of Geology, and indexes of serials and publishers, authors, and subjects are included in the volume.—M.C.M.

Oakes, E. L. *See* Cotter, R. D. 5608

5727 **Oakeshott, Gordon B.** San Andreas fault—Predominant lateral or vertical displacement?: San Joaquin Geol. Soc. Selected Papers, v. 3, p. 4–18, illus., 1965.

The origin, nature, and history of movement on the San Andreas and related faults are not clear. Late Quaternary evidence strongly favors predominant right-slip displacement, but late Cretaceous and Tertiary stratigraphy, structure, and geologic history, which can be matched across the fault in central and northern California, leave little room for strike-slip displacement of more than a mile or two. Distribution of late Mesozoic Franciscan rocks and granitic rocks of near-equivalent age cannot be explained by large strike-slip movement, but neither does it require vertical displacements of more than 10 mi. For the present, multiple working hypotheses should be retained concerning displacement on these faults.—E.S.L.

Obenchain, R. *See* Forbes, C. B. 5679

5847 **O'Brien, J. C.; Aune, Q. A.; Lydon, P. A.; Goldman, H. B.; Davis, Fenelon P.** Mines and mineral resources of Trinity County, California: California Div. Mines and Geology County Rept. 4, 125 p., illus., tables, geol. maps, 1965.

About three-fourths of this county lies within the rugged Klamath Mountains where streams have carved deep canyons. Rocks range in age from late Pleistocene or Recent terrace deposits in the Minersville area to pre-Silurian metamorphics in the central part of the county, which were complexly deformed near the close of the Jurassic period, and intruded by serpentine, diorite and granodiorite. In the southwestern part of the county the Northern Coast Ranges are folded and faulted Mesozoic sedimentary rocks, mostly in the Franciscan Formation. Gold placers have been the chief source of mineral wealth; the history of production is reviewed. Quicksilver and other metals also have been produced, and since 1956 stone, sand and gravel. Ore deposits unprofitable to exploit in former years now have potential resources, which are tabulated.—G.D.C.

Oda, Uteana. *See* Specht, Alston W. 5656

5845 **Oglesby, Woodson R.** Folio of South Florida Basin—A preliminary study: Florida Geol. Survey Map Ser. 19, 3 p., illus., 1965.

As outlined on the accompanying isopach and structure contour maps, this basin extends over 77,000 sq mi, about half of which is dry land. Well cores confirm repeated Lower Cretaceous cycles of sea-water influx followed by evaporation. In

the lower 250 feet of the Punta Gorda Formation evaporites predominate, with carbonates in seven isolated portions; the next 40 feet of dark brown cryptocrystalline limestone, which appears petroliferous, is capped by 40 feet of anhydrite. The Sunniland Limestone occurs as a biostrome running through Charlotte Harbor to Key Largo; within it are reef-like bioherms and inter-reef lime muds, now indurated. This limestone, largely replaced by evaporites in the trough that parallels the coasts of Collier and Monroe Counties, is present in the Marquesas Keys. Evaporites are absent in Upper Cretaceous, but cycles recur in Paleocene, followed by formation of the present platform.—G.D.C.

5766 **Okeson, Clifford J.; Frink, John W.** Estimating reservoir losses by multiple techniques at Sulphur Lake, Washington: Eng. Geology, v. 2, no. 2, p. 9–19, illus., 1965.

Usefulness of the proposed Sulphur Lake Reservoir on Washtucna Coulee, near Pasco, could be limited by excessive seepage losses through openwork gravels in the coulee floor and through basalt interflows to the Snake River six miles away and 420 feet lower. A reasonable estimate of reservoir losses was arrived at by combining a multiplicity of approaches—geologic mapping, gravity survey, diamond and cable tool drilling, pumping-in permeability tests, specific capacity of water wells, a reconstructed water-table map, and an electric analog. Geologic sketch maps and cross sections are included.—E.S.L.

5554 **Olcott, Perry G.** Geology and water resources of Winnebago County, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1814, 61 p., illus., tables, geol. map, 1966.

Sources of water in Winnebago County include surface water from Fox and Wolf Rivers and associated lakes, and ground water from sandstone, dolomite, and sand and gravel deposits. A thick southeastward-dipping sandstone aquifer underlying the county yields as much as 1,000 gpm, and a dolomite aquifer in the east and south and sand and gravel layers and lenses in preglacial bedrock channels in the northwest and in upper Fox River valley up to 50 gpm in wells. Present water problems include algae and local pollution in Lake Winnebago Pool, iron in water from the sandstone aquifer, and saline ground water in the east. Potential problems are rapid decline of water levels, migration of saline ground water, and various kinds of pollution.—*from* Author's abstract

5616 **Olive, Wilds W.** Geologic map of the Paducah East quadrangle in western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-531, scale 1:24,000, section, text, 1966.

Gravel of Pliocene(?) and Pleistocene deposits is occasionally mined for road metal from pits scattered throughout the Paducah East quadrangle. The Porters Creek Clay has potential value as a source of fuller's earth. Fair- to good-quality water for domestic stock use is generally obtainable at relatively shallow depths.—M.C.M.

5981 **Ollerenshaw, N. C.** Geology, Burnt Timber Creek, west of fifth meridian, Alberta: Canada Geol. Survey Prelim. Ser. Map 11-1965, scale 1:63,360, sections, text, 1966.

Burnt Timber Creek map-area in the southern Foothills of Alberta may be divided into three principal structural units, underlain from west to east by the McConnell, Burnt Timber, and Fallentimber thrusts, respectively. The Paleozoic to Tertiary map-units are described in some detail. Of the 16 wells drilled to date, eight have been capped as potential gas producers in Mississippian and Devonian reservoir rocks.—M.C.M.

5890 **Olson, Everett C.** Community evolution and the origin of mammals: Ecology, v. 47, no. 2, p. 291–302, illus., table, 1966.

The evolutionary course from primitive pelycosaurian reptiles through therapsids to mammals can be related to modifications of the structure of the communities in which these reptiles existed. Three types are recognized on the basis of the nature of the food chain; each has an important tetrapod component. Early phases of the evolution were tied to water; pelycosaur-therapsid communities developed terrestrial reptilian herbivores. Terrestrial communities developed concurrently, with

insects, which were a food source, as the principal herbivores. With lepidosaurian–archosaurian radiation, the terrestrial communities came into competition, the therapsid lines temporarily unsuccessful leaving only small but very mammal-like representatives in the late Triassic. These remnants provided the basis for the radiation of mammals that led to great successes of the Cenozoic era.—*from* Author's abstract

5959 **Onken, Hajo.** Verfeinerung der Kristallstruktur von Monticellit [with English abs.]: Tschermaks Mineralog. u. Petrog. Mitt., ser. 3, v. 10, nos. 1–4, p. 34–44, tables, 1965.

As part of a detailed study of minerals of the olivine group the structure of monticellite ($MgCaSiO_4$) was redetermined and refined. The structure, as given by Brown and West (1927), was found to be fundamentally correct. Thirteen cycles of least-squares refinement on the IBM 7094 computer reduced the disagreement factor, R, for 345 hkl reflections from an initial value of 0.439 to a final value of 0.068. A comparison of atomic distances and bond angles with previously determined data of olivine and fayalite showed remarkable agreement.—Author's abstract

5723 **Orsborn, John F.** The prediction of piezometric groundwater levels in observation wells based on prior occurrences: Water Resources Research, v. 2, no. 1, p. 139–144, illus., tables, 1966.

Many water-table and artesian wells exhibit annual cyclic fluctuations in their water levels between a maximum in the spring and a minimum in the summer or fall. These show a normal probability distribution, and the minimum that will occur following the maximum can be predicted. It has been found that the correlation between the annual maximum and minimum levels in a particular well can be applied to other wells in the same aquifer, or to wells in other aquifers with similar characteristics and piezometric declines. An example of this method using selected Wisconsin wells, and results of the analysis are presented.—E.S.L.

5773 **Osmond, John C.** The geology of Nevada—An exploration frontier [abs.]: Mtn. Geologist, v. 3, no. 1, p. 47, 1966.

Osterkamp, T. E. *See* Hoekstra, T. E. 5992

Overstreet, Elizabeth F. *See* Dunlap, John C. 5780

Owens, James P. *See* Minard, James P. 5931

5960 **Pabst, A.** A. N. Winchell's observations on plagioclase, 1900—An historical note [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., ser. 3, v. 10, nos. 1–4, p. 69–72, illus., 1965.

Winchell's observations and interpretations anticipated the work of recent decades on the differences between the optical properties of plutonic and "high-temperature" plagioclases.—Author's abstract

5901 **Park, Frederick R.; Bunch, Theodore E.; Massalski, Tadeusz B.** A study of the silicate inclusions and other phases in the Campo del Cielo meteorite: Geochim. et Cosmochim. Acta, v. 30, no. 4, p. 399–414, illus., tables, 1966.

Results are presented of a detailed study of the material occurring as inclusions and the surrounding matrix of a specimen of the Campo del Cielo meteorite. These inclusions are composed of silicates associated with a large amount of opaque minerals, and are separated from the metallic matrix by a complex interface region. The texture of the minerals of interface region (mainly schreibersite, troilite, and graphite) indicates initial heating followed by relatively rapid cooling. The mineral suite of the silicates is similar to silicate inclusions in otherwise metallic meteorites and to some terrestrial rocks, but differs considerably from typical chondritic or achondritic material.—D.B.V.

5913 **Partheniades, Emmanuel.** Erosion and deposition of cohesive soils [reply to discussions of paper 4204, 1965]: Am. Soc. Civil Engineers Proc., v. 92, paper 4805, Jour. Hydraulics Div., no. HY3, p. 79–80, 1966.

The writer's first investigation was limited to the effect of some mechanical factors on erosion and deposition of cohesive soils under a constant water environment. This environment may be important and its effect on erodibility, flocculation, and deposition should be investigated. Christianson's observation on the contrast of deviation of lift force near the bed and on a rough wall constitutes a sound argument for the normality of the velocity fluctuations, but needs more research with regard to various shapes and sizes of roughness. The writer recognizes effects of variation of interparticle bonds. A number of corrections are made in the original paper.—G.D.C.

5559 **Patrick, Ruth.** The diatoms, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 74–77, illus., 1966.

A study was made of two cores from the Recent lake sediments. Evidence of a diatom flora was found only at 163 cm in core 2 and at 194.5 cm in core 3. The two floras were remarkably similar. One new species, *Mastogloia*, is described. The results of the studies indicate that when these sediments were laid down the lake was fresh and fairly deep, and the water was probably warm.—E.S.L.

Pattee, Eldon C. *See* Walker, George W. 5697

5750 **Patterson, M. S.; Weiss, L. E.** Experimental deformation and folding in phyllite: Geol. Soc. America Bull., v. 77, no. 4, p. 343–374, illus., 1966.

Experimental deformation of strongly anisotropic phyllite at room temperature and high confining pressure was principally by gliding on foliation—providing direction of compression was parallel, or nearly parallel, to foliation. Shortening phenomena include kinks, conjugate folds, and more tightly appressed similar folds produced in this order as shortening increased. It is suggested that flexural slip folding may produce many natural similar folds.—R.G.Y.

Pawluk, S. *See* Arshad, M. A. 5829

5848 **Payne, B. R.; Cameron, J. F.; Peckham, A. E.; Thatcher, L. L.** The role of radioisotope techniques in hydrology [with French, Russian, and Spanish abs.], *in* Internat. Conf. Peaceful Uses Atomic Energy, 3d, Geneva, 1964, Proc., V. 15, Special aspects of nuclear energy and isotope applications: New York, United Nations, p. 226–238, illus., 1965.

Isotope techniques are already being used in many branches of hydrology. For ground-water studies the application may be localized, involving artificially injected radioisotopes; regional, making use of environmental radioactivity; and borehole logging for measuring relevant lithological characteristics. Specific problems include underground storage studies, pumping tests, permeability changes in strata, tracing of water in karst terrain, or mine leakage. Applied to surface water resources, the mass rate of sediment transport is of concern, not only in reservoirs, but also in navigable rivers and estuaries.—G.D.C.

6019 **Peck, Dallas L.** Lava coils of some recent historic flows, Hawaii, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B148–B151, illus., 1966.

Coiled strips of lava occur on the surface of Alae lava lake, formed by the August 1963 eruption of Kilauea Volcano, and in the feeder channels of the 1954, October 1963, and March 1965 Kilauean flows. They were observed in the process of formation on Makaopuhi lava lake during the March 1965 eruption. The coils that occur along shear zones display a consistent sense of coiling along each zone and indicate the relative direction of movement—coils that spiral inward in a clockwise direction record right-handed shear, and in a counterclockwise direction, left-handed shear. The shears and coils in Alae lava lake show that during a late

stage of the eruption, lava flowed outward from the vents beneath the crust in a stream that shifted from one side to the other of the major axis of the lake. Author's abstract

Peckham, A. E. *See* Payne, B. R. 5848

5668 **Petersen, R. G.; Calvin, L. D.** Sampling, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 54–72, illus., tables, 1965.

Soils are characterized by several types of variation which should be kept in mind in sampling. Plans suggested include judgment sampling, simple and stratified random sampling, and one- and two-dimensional systematic sampling. Sources of errors are divided into three categories—sampling, selection, and measurement errors. Subsampling and composite samples are discussed also.—E.S.L.

Peterson, F. F. *See* Gile, L. H. 5969

Petty, A. J. *See* Henderson, J. R. 5601

5950 **Pickering, R. J.** River-bottom sediment sampling with a Swedish Foil Sampler, *in* Selected techniques in water resources investigations, 1965: U.S. Geol. Survey Water-Supply Paper 1822, p. 94–99, illus., 1966.

The collecting of undisturbed core samples of fine, somewhat fluid sediment is hampered by the tendency of the sediment to adhere to the interior of the sampling tube and thus cause compaction and preferential coring of certain sediment layers. In the Swedish Foil Sampler, this tendency is minimized by the insertion of a sheath of metal "foils" between the sediment core and the sample tube. The foils hold the sediment sample in place and let the sample tube move downward without carrying the sediment sample along with it and without compacting the sediment.—Author's abstract

Pitkin, J. A. *See* Meuschke, J. L. 5602

Pittillo, D. R. *See* Boynton, G. R. 5593

Pittillo, D. R. *See* Boynton, G. R. 5594

Pittillo, D. R. *See* Boynton, G. R. 5595

Pittillo, D. R. *See* Boynton, G. R. 5596

6016 **Plafker, George; MacNeil, F. S.** Stratigraphic significance of Tertiary fossils from the Orca Group in the Prince William Sound region, Alaska, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B62–B68, illus., 1966.

The Orca Group, a thick complexly deformed and sparsely fossiliferous sequence of eugeosynclinal clastic and volcanic rocks, underlies an area of roughly 4,000 sq mi in the southern and eastern Prince William Sound region. New collections of marine megafossils from the lower volcanic unit and pollen from the sedimentary upper part indicate that the Orca Group is early Tertiary rather than Mesozoic age as previously inferred. The Orca Group was deposited during early Tertiary in a geosyncline along the present northern and western margin of the Gulf of Alaska. A minor period of orogeny probably culminating in late Eocene or early Oligocene resulted in complex deformation, in emplacement of granitic batholiths, and in economically important copper, gold, and antimony mineralization.—*from* Authors' abstract

5604 **Popenoe, Peter.** Aeroradioactivity and generalized geologic maps of parts of New York, Connecticut, Rhode Island, and Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-359, scale 1:250,000, text, 1966.

The survey area of 10,500 sq mi spans parts of the New England, Valley and Ridge, and Coastal Plain provinces. Radioactivity levels range from 250 to 1,350 cps; low radioactivity is associated with mafic and quartzose rocks and glaciofluvial and glaciolacustrine deposits, and relatively high radioactivity with many granitic rocks. Several anomalies have no obvious geologic explanation and are believed not due to natural effects. The map sheet includes sketch maps showing major structural units, surficial geology of the entire area, and geology of parts of southeastern New York and southern New England.—M.C.M.

5735 **Popenoe, Peter.** Aeroradioactivity survey and areal geology of the Denver area, Colorado (ARMS–I): U.S. Atomic Energy Comm. Civil Effects Study CEX–59.4.26, 26 p., illus., tables, 1966.

Results of the airborne gamma–radiation survey of 6,500 sq mi near Denver, Colo., indicate a wide range of natural radioactivity; general distribution is attributed to the geology. The area lies in the Colorado Piedmont section of the Great Plains physiographic province which is underlain by Paleozoic, Mesozoic, and Cenozoic sedimentary rocks and Quaternary surficial deposits. Natural gamma radioactivity within the area ranges from 300–1,550 cps. High levels are generally associated with arkosic and conglomeratic rocks, low levels with argillaceous and arenaceous sedimentary rocks and eolian sand and loess.—M.C.M.

Post, E. V. *See* Mallory, W. W. 5628

5974 **Powers, William E.** Physical geography: New York, Appleton–Century–Crofts, 566 p., illus., tables, 1966.

Successive sections of the textbook deal with development of landforms; regional description of the United States and southern Canada in terms of physiographic provinces; weather, as the principal environmental influence on man; climate, principal distinctive types and world regions in which they predominate; and Earth resources, including mineral deposits and water resources. An appendix explains types of map projections and their uses.—E.S.L.

5869 **Pratt, R. M.** The Gulf Stream as a graded river: Limnology and Oceanography, v. 11, no. 1, p. 60–67, illus., 1966.

The Gulf Stream flowing north through the Straits of Florida and across the Blake Plateau has many characteristics of a graded river. It transports water and sediment in such a manner that it neither erodes nor aggrades its channel. The delicate balance between erosion and deposition is emphasized by the presence of scour depressions and aggradational banks side by side on the bottom, and the well–sorted Globigerina sand being winnowed over a bottom partly encrusted with manganese nodules. The hydraulic geometry of the Gulf Stream is also comparable to large rivers on land.—*from* Author's abstract

5756 **Pratt, Wallace E.** Memorial to Arville Irving Levorsen (1894–1965): Geol. Soc. America Bull., v. 77, no. 4, p. P61–P66, portrait, 1966.

Prentiss, D. D. *See* Sutton, G. H. 5654

5658 **Prince, Allan B.** Absorption spectrophotometry, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 866–878, illus., table, 1965.

Principles explained are interaction of light with matter and the laws of absorption. Single–beam and double–beam filter photometers are described, and some errors that may occur with the photometric colorimeter are discussed. Spectrophotometers are described and the characteristics tabulated. A section on calibration concludes the paper.—E.S.L.

Pringle, J. K. *See* Austin, C. F. 5789

5965 **Purdy, J.; York, Derek.** A geochronometric study of the Superior province near Red Lake, northwestern Ontario: Canadian Jour. Earth Sci., v. 3, no. 3, p. 277–286, illus., tables, 1966.

Nine samples of granites and gneisses collected along a 125 mi traverse running south from Red Lake have been analyzed in a Rb–Sr whole-rock study. It is concluded that an isochron may meaningfully be drawn through points representing these samples on a Nicolaysen (1961) plot. A slope equivalent to an age of 2.45±0.10 b.y. results. If the gneisses represent the residue of an ancient crust then the Rb–Sr data yield little evidence of this and the effect of the Kenoran orogeny is clearly the dominant feature. K–Ar amd Rb–Sr dating of biotites separated from two of the gneisses indicates that the area has been more mildly affected by a later metamorphism.—Authors' abstract

Raabe, R. G. *See* Ketner, K. B. 5859

5560 **Raček, A. A.** Spicular remains of freshwater sponges, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 78–83, illus., 1966.

Spicules present in cores of the Recent lake sediments were examined under phase contrast, and counted. Their relative abundance is shown graphically. A taxonomic evaluation of the two types distinguished is given, and typical spicules are illustrated. One core has many more spicules than the other, but both have none in the upper levels, and the maxima are more or less equivalent. There seems to be no correlation between water content and spicular abundance. Identity of the sponges could not be established.—E.S.L.

Rader, L. F. *See* Huffman, Claude, Jr. 5904

Radtke, A. S. *See* MacKevett, E. M., Jr. 6021

Ragan, Donal M. *See* Foster, Helen L. 5940

Ragland, Paul C. *See* Billings, Gale K. 5814

5970 **Raleigh, C. B.** Structure and petrology of an alpine peridotite on Cypress Island, Washington, U.S.A.: Beitr. Mineralogie u. Petrographie, v. 11, no. 7, p. 719–741, illus., 1965.

The Cypress peridotite is typical of ultramafics of the alpine type and contains relict layering and accumulative textures which show it to have originated by crystal settling from a magma of unknown initial composition. Parallelism of lineations and *b*-axes of folds in the layering with orientations in fabrics of olivine crystals is considered to have arisen through penetrative deformation of the mass accompanied by plastic flow or recrystallization of the olivine. Veins of pyroxenite which have not participated in the folding give an indication of the minimum temperature of the deformation. The peridotite was deformed, possibly during intrusion, as a crystal mush, filter pressing due to compaction or recrystallization removing all but a small percentage of the magmatic fraction which then crystallized following cessation of movements.—*from* Author's abstract

5747 **Ralph, Elizabeth K.; Han, Mark C.** Dating of pottery by thermoluminescence: Nature, v. 210, no. 5033, p. 245–247, illus., tables, 1966.

Some of the major uncertainties which must be investigated or circumvented in order to use thermoluminescence as a means of dating pottery have been studied in experiments described here. The results are encouraging. A pottery time scale based on sherds from Iran and Italy has been established; if it is found to be applicable for all, there will be no question of the reliability of thermoluminescence dating. If the consistency of the measurements is improved, the precision may be comparable with that of C-14 dating, and thermoluminescence affords the extra advantage that the pottery itself (abundant and primary) is dated rather than something (such as charcoal) associated with it.—D.B.V.

Ramos, E. *See* Miro, M. 5722

5685 **Randolph, J. R.; Deike, R. G.** Bibliography of hydrology of the United States 1963: U.S. Geol. Survey Water-Supply Paper 1863, 166 p., 1966.

This bibliography, the first of an annual series, lists references to books, journal articles, and other publications in the field of hydrology published in the United States during 1963. Some references to material published in Canada have been included, and, in addition, some references have been taken from international journals. An index is included combining subject and geographic headings.—W.L.G.

Rapson, J. E. *See* Deans, T. 5746

5938 **Ray, Louis L.** Pre-Wisconsin glacial deposits in northern Kentucky, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B91-B94, illus., 1966.

Three tills of pre-Wisconsin age are present in Kentucky. The oldest, the Nebraskan, is most widespread and most deeply weathered, and occurs on remnants of a preglacial upland. Till of Kansan age is less widespread and less deeply weathered, overlies the Nebraskan till on the upland near Cincinnati, and is present elsewhere at subsummit positions in valleys cut in the glaciated upland during Aftonian time. The youngest till, the Illinoian, is least weathered, and is present at a few places within the Ohio Valley, entrenched during Yarmouth time, and on the adjacent hills southeast of Cincinnati.—Author's abstract

Redman, R. H. *See* Frederickson, E. A. 5621

5882 **Reed, Kenneth John.** Biometric study of the embryonic apparatus of selected species of the genus *Lepidocyclina* (Foraminifera) [abs.]: Dissert. Abs., v. 26, no. 11, p. 6648, 1966.

5935 **Reynolds, Mitchell W.** Stratigraphic relations of Upper Cretaceous rocks, Lamont-Bairoil area, south-central Wyoming, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B69-B76, illus., table, 1966.

Unconformities in Upper Cretaceous rocks of south-central Wyoming mark areas of uplift and erosion, and account for the thinning and absence of the Mesaverde Formation near Lamont and Bairoil. An unconformity at the base of the Teapot Sandstone Member of the Mesaverde bevels the underlying part of the Mesaverde from south to north. Local tectonic activity in post-Teapot and early Lewis time resulted in additional uplift and in truncation of the Mesaverde Formation across the area by marine planation. Maximum truncation of strata occurs on the west and north flanks of Lost Soldier anticline, where the Mesaverde is absent; and on the south flank of the Sweetwater arch, where the Mesaverde is absent and the Lewis Shale lies on progressively lower portions of the Cody Shale.—Author's abstract

5874 **Reynolds, R. Stanton.** An unattended seismological observatory: IEEE Proc., v. 53, no. 12, p. 1890-1899, illus., 1965.

Prototype equipment to continuously record outputs from three short-period and three long-period unattended seismometers for up to 120 days is being developed and tested. Timing accuracy will be within 0.1 sec throughout the record period. The system will be capable of recording a 70 decibel signal range. As much as 42 decibel attenuation can also be applied to each short-period data channel by an automatic gain control system to compensate for high levels of background noise. A playback system being developed will convert the recorded data and timing signals to standard Vela Uniform tape format.—*from* Author's abstract

5657 **Rich, C. I.** Elemental analysis by flame photometry, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 849-865, illus., 1965.

Principles considered are excitation and emission, and spectral interferences (direct and indirect). The section on instrumentation deals with controlling flame temperature, delivery of test solution to the flame, and isolation of radiation. Preparation of the solution is described, and methods for overcoming spectral interferences. Helpful data on four of the commonest soil elements are given, and general methods for specific extracts outlined. A note on precision and accuracy concludes the paper.—E.S.L.

5689 **Richter, Donald H.; Moore, James G.** Petrology of the Kilauea Iki lava lake, Hawaii: U.S. Geol. Survey Prof. Paper 537-B, p. B1-B26, illus., tables, 1966.

During 1959, a summit eruption of Kilauea Volcano filled the crater of Kilauea Iki to a depth of 365 feet with 50 million cu yd of tholeiitic basalt. The crust of this lava lake was penetrated by four drill holes and petrologic and thermometric studies were made. Twenty chemical analyses and 45 modal analyses of the rocks and melt portray the chemical and mineralogical properties of the crust five times during the early lake history. Most changes in composition are due to gravity settling and filter pressing. Chemical analyses indicate a zone of transient alkali enrichment immediately below the crust. If analogous conditions exist in the magma reservoirs of the Hawaiian volcanoes, this alkali enrichment, coupled with removal of clinopyroxene by settling, may explain formation of alkalic basalt from a tholeiite parent.—D.H.R.

Riegel, Walter. *See* Habib, Daniel, 5899

5883 **Riegel, Walter Leonard.** Palynology of environments of peat formation in southwestern Florida [abs.]: Dissert. Abs., v. 26, no. 11, p. 6648-6649, 1966.

5985 **Ringwood, A. E.** Genesis of chondritic meteorites: Rev. Geophysics, v. 4, no. 2, p. 113-175, illus., tables, 1966.

Abundance patterns of the major classes of chondrites are defined. The composition of type I carbonaceous chondrites shows that they have a simpler chemical and thermal history than other classes, and may be closely related to the dust of the parent nebula. Other classes of chondrites may have been derived from this parental material by complex fractionation mechanisms. Mineralogy of the classes of chondrites is reviewed and the significance of the assemblages discussed. A detailed review of oxidation-reduction relationships is given. Chondrites display a wide range of oxidation states. The structure and texture of chondrites are discussed and three hypotheses for their origin are reviewed: primary origin of chondrules, autoreduction within the parent body followed by surface volcanism, and impact origin (new and speculative). No current theory is satisfactory.—E.S.L.

5641 **Roberts, Thomas N.; Burns, Kenneth R.** (compilers). Oil and gas fields of Oklahoma, 1965: Oklahoma Geol. Survey Map GM-10, scale 1:750,000, 1966.

Robinson, G. D. *See* Mudge, M. R. 5998

5956 **Roboz, John.** Mass spectrometry, Chap. 11 *in* Trace analysis, physical methods: New York, Interscience Publishers, p. 435-509, illus., 1965.

The objective of this chapter is to survey the instrumentation presently available, to describe recently developed techniques, to discuss problems and limitations involved, and to review a number of representative applications, with emphasis on solids analysis. Four techniques are discussed: electron bombardment, in which special methods for trace analysis of organic gases and arrangements of solids are described; isotope dilution, slow, but the most sensitive and most accurate method in geochemistry used in both physical and biological sciences; ion bombardment, nondestructive, suitable for the study of surfaces; and spark source, most useful for exploring impurities in almost any matrix. A selected list of references is given for comprehensive treatments.—G.D.C.

5948 **Rogers, John J. W.; Donnelly, Thomas W.** Radiometric evidence for the origin of eugeosynclinal materials: Tulane Studies Geology, v. 4, no. 3, p. 133-138, tables, 1966.

Thorium and uranium contents of eugeosynclinal graywackes and associated volcanic rocks are similar and are in the range of 1–2 ppm thorium and 0.5–1 ppm uranium. These values are much lower than average concentrations in the continental crust and apparently indicate derivation of orogenic material directly from the upper mantle without contribution from the craton. The paper is based on work done in the Greater Antilles and western Oregon and Washington.—E.S.L.

5849 **Rogers, Thomas H.** (compiler). Geologic map of California, Olaf P. Jenkins edition—Santa Ana sheet: [San Francisco, Calif.] California Div. Mines and Geology, scale 1:250,000, separate explanatory sheet, 1965.

The explanatory sheet includes an index to geologic mapping used in compilation of the map, a stratigraphic nomenclature chart, and illustrations.—M.C.M.

Román de Vega, V. *See* Miro, M. 5722

5664 **Romey, William D.** A strategy for alleviating the shortage of earth science teachers: Jour. Geol. Education, v. 14, no. 3, p. 89–90, 1966.

In order to provide the large numbers of teachers needed over the next few years we must use every possible resource. As a first tactical move, a well developed program of in-service institutes and temporary local testing and training centers is essential. At the same time, all institutions involved in preparation of earth science teachers must reevaluate their curricula in the light of demands inherent in the Earth Science Curriculum Project course.—Author's summary

Romney, C. F. *See* Green, P. E., Jr. 5678

5738 **Rose, Arthur W.** Geology of part of the Amphitheatre Mountains, Mt. Hayes quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 19, 12 p., illus., tables, geol. map, 1966.

Reconnaissance mapping in the Amphitheatre Mountains north of the Denali Highway shows that basalt and andesite flows, silicate tuffs and tuffaceous sediments, and andesite agglomerate of the Triassic(?) Amphitheatre Formation are intruded by gabbro, granite, and peridotite. Some of the gabbro appears to be a thick layered sill or lopolith; other gabbro and diabase occur as sills in the tuffs and tuffaceous sediments. In general sediments and sills dip gently northward. A layer of mafic gabbro about 150 feet thick contains about 22 percent iron in magnetite and ilmenite. A magnetic concentrate contained 47 percent iron and 11.1 percent TiO_2. Stream sediment sampling detected several copper anomalies which deserve a follow up.—Author's abstract

Rose, Harry J., Jr. *See* Adler, Isidore. 5953

5650 **Rosenberg, P. E.; Mills, J. W.** A mechanism for the emplacement of magnesite in dolomite: Econ. Geology, v. 61, no. 3, p. 582–586, 1966.

Above 200°C, magnesite rather than dolomite is the phase stable with CO_2-bearing solutions with Ca:Mg ratio of unity. Solutions formed below 200°C by attack of CO_2-bearing water on dolomite will lead to replacement of dolomite by magnesite when heated to above 200°C. It is not necessary to assume addition of Mg from outside sources.—W.S.W.

5877 **Ross, Arnold.** *Armatobalanus* in the Miocene of Maryland: Florida Acad. Sci. Quart. Jour., v. 28, no. 4, p. 332–338, illus., 1965.

The cirriped *Balanus (Armatobalanus) calvertensis* n. sp., is described from the middle Miocene Choptank Formation at Calvert Beach, Md. It is the oldest species definitely referable to the subgenus *Armatobalanus*. The new species resembles *B. circe* in the strongly crenate ornamentation of the external surface of the scutum, but is easily distinguished by absence of an adductor ridge on the internal surface of the scutum. Distinctions from *B. nefrens, B. inclusus, and B. allium* are discussed also.—V.M.J.

5544 **Ross, Howard Persing.** In situ determination of the remanent magnetic vector of two-dimensional tabular bodies [abs.]: Dissert. Abs., v. 26, no. 11, p. 6649, 1966.

Rozman, Kh. S. *See* Sartenaer, P. 6009

Ruane, P. J. *See* Mallory, W. W. 5628

Rudy, H. R. *See* Edmonton Geological Society. 5817

5757 **Ruhlman, E. Robert.** Memorial to Bertrand Leroy Johnson (1882–1962): Geol. Soc. America Bull., v. 77, no. 4, p. P57–P59, portrait, 1966.

5731 **Rush, F. Eugene; Huxel, Charles J., Jr.** Ground-water appraisal of the Eldorado–Piute Valley area, Nevada and California: Nevada Dept. Conserv. and Nat. Resources, Water Resources—Reconn. Ser. Rept. 36, 29 p., illus., tables, 1966.

Unconsolidated alluvium, where saturated, forms the best aquifer in the arid Eldorado–Piute Valleys; consolidated rocks are relatively impermeable and, except where they give rise to springs, are not important ground-water sources. Estimated average annual ground-water recharge is 1,100 acre-feet in Eldorado Valley, 2,400 acre-feet in Piute Valley, and 200 acre-feet in the adjacent part of the Colorado River valley. Present development of ground water is less than 100 acre-feet per yr, and most of this is pumped by the town of Searchlight. Total amount of recoverable ground water in the upper 100 feet of saturated alluvium is estimated at about 1,000,000 acre-feet in Eldorado Valley, about 1.5 million acre-feet in Piute Valley, and about 1,000,000 acre-feet in the adjacent Colorado River valley. Chemical quality is considered only fair to poor.—*from* Authors' abstract

Rush, F. Eugene. *See* Everett, D. E. 5834

5585 **Sadlick, Walter.** Biostratigraphy of the Chainman Formation (Carboniferous), eastern Nevada and western Utah [abs.]: Dissert. Abs., v. 26, no. 10, p. 5978, 1966.

5549 **Saint Clair, Charles Spencer.** The classification of minerals—Some representative mineral systems from Agricola to Werner [abs.]: Dissert. Abs., v. 26, no. 11, p. 6682–6683, 1966.

5671 **Sallberg, John R.** Shear strength, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 431–447, illus., 1965.

In testing for shear strength, external forces are applied to the soil specimen in such a way that two adjoining parts slide relative to each other. This measurement can be made either in place or in the laboratory. In-place measurements include vane-shear, plate-load, and penetration tests. Laboratory tests include miniature vane-shear, direct shear, and triaxial and unconfined compression. The last three are described in detail.—E.S.L.

5769 **Samuelson, W. J.** Engineering geology of the NORAD Combat Operations Center, Colorado Springs, Colorado: Eng. Geology, v. 2, no. 2, p. 20–30, illus., table, 1965.

Comprehensive surface and subsurface investigations were made to determine the petrographic and structural characteristics of the Pikes Peak Granite prior to construction of a series of deep tunnels and rooms in Cheyenne Mountain. Several thousand feet of NX continuous core and borehole camera studies were made, and physical properties tests were carried out on rock samples. A joint system was predicted to be continuous to the heart of the mountain, and the chambers were reoriented to be compatible with it.—E.S.L.

6009 **Sartenaer, P.; Rozman, Kh. S.** O yedinom complekse Famenskikh rhinkhonellid Severnoy Ameriki i Urala: Akad. Nauk SSSR Paleont. Zhur. 1965, no. 1, p. 148–

150, illus., 1965; English translation, Internat. Geology Rev., v. 7, no. 12, p. 2102–2104, illus., 1965.

The authors have concluded that *Pseudoleiorhynchus uralicus* is part of the genus *Trifidorostellum*. *T. dunbarense* has been described from the topmost layers of the Devonian Three Forks Formation in Montana, and it is concluded that there are no Upper Fammenian deposits present. Early Fammenian *T. dunbarense* and Late Fammenian *T. uralicum* form a single group species of value in intercontinental correlation of Fammenian beds.—E.S.L.

Sax, R. L. *See* Archambeau, C. V. 5651

Schlanger, S. O. *See* Weir, G. W. 5691

Schnepfe, Marian. *See* Grimaldi, F. S. 5903

Schoewe, Walter H. *See* Howard, Leonard W. 5797

5799 **Schoewe, Walter H.** (compiler). Theses—1965: Kansas Acad. Sci. Trans., v. 68, no. 2, p. 336–348, tables, 1965.

This compilation of theses for 1965 submitted for advanced degrees at Kansas state schools follows those for earlier years. Theses are listed by the field of science and include those fields commonly represented at the Academy's annual meetings. A total of 221 are listed of which approximately ten percent were in geology. A summary tabulation is included.—E.S.L.

5828 **Schopf, Thomas J. M.** Conodonts of the Trenton Group (Ordovician) in New York, southern Ontario, and Quebec: New York State Mus. and Sci. Service Bull. 405, 105 p., illus., tables, 1966.

Type area collections of approximately 55,000 conodonts from 195 limestone samples from 12 sections of the Trenton and middle and upper part of the Simcoe Groups, and 370 conodonts from 19 samples from the underlying Black River and lower part of the Simcoe Group are the basis for zonation and correlation suggested here. Systematic descriptions are given for 69 species, 7 of which are new. Several conodont groups are suggested, based on common occurrence of species. Biostratigraphy and local and regional correlations are discussed. Seven charts show conodont distribution.—E.S.L.

5620 **Schrenk, W. G.; Ho, Show-jy.** Spectrographic determination of rhenium in molybdenite with the DC arc, *in* Developments in applied spectroscopy, V. 4—Annual Mid-America Spectroscopy Symposium, 15th, Chicago, Ill., 1964, Proc.: New York, Plenum Press, p. 517–525, tables, 1965.

Rhenium in molybdenite can be determined, only with preliminary chemical concentration of the rhenium, by an emission-spectrographic procedure described here which produced satisfactory results. Possible interfering lines of other nearby elements are listed. Potassium perrhenate as a source of rhenium was used for preliminary studies and to prepare standards. Three samples of molybdenite having low, medium, and high concentrations of rhenium were used to determine the usefulness of the procedure. Averages, respectively, were 84.4, 407, and 821 ppm rhenium per gram molybdenite, with cobalt used as an internal standard.—G.D.C.

5666 **Schumm, S. A.** The development and evolution of hillslopes: Jour. Geol. Education, v. 14, no. 3, p. 98–104, 1966.

Two types of slopes (valley-side and scarps) are referred to here as hillslopes. History of the study is reviewed from the Davis and Penk theories to the dynamic approach of Schumm and Lichty. Hillslope forms are described, and the theoretical and empirical approaches to erosion and evolution discussed. The empirical approach involves both experimental and natural studies. Information in the latter can be obtained either by measuring hillslope erosion or by comparing forms of hillslopes of different ages. Both are discussed and examples described.—E.S.L.

Schwerdtner, W. M. *See* Wardlaw, N. C. 5749

5895 **Scott, Nina.** Operation and results of the earthquake questionnaire program, *in* Earthquake investigations in the western United States, 1931–64: U.S. Coast and Geod. Survey Pub. 41–2, p. 205–211, illus., 1965.

The current system of obtaining descriptive information on earthquakes by means of questionnaires collected by the U. S. Coast and Geodetic Survey was established in 1937 and involves the collaboration of individuals in various state universities, bureaus of mines, or seismological stations and government agencies. An example of the post card questionnaire and the earthquake intensity maps derived from the information received are illustrated.—V.S.N.

5951 **Seaber, Paul R.; Vecchioli, John.** Use of soil-consolidation test data to determine permeability of clays, *in* Selected techniques in water resources investigations, 1965: U.S. Geol. Survey Water-Supply Paper 1822, p. 105–113, illus., 1966.

Laboratory tests to determine the permeability of clays are done generally with a variable-head permeameter. Permeability may also be computed from consolidation-test data based on Terzaghi's theory of consolidation. For fine textured materials, permeability values obtained indirectly from consolidation tests commonly are smaller than those obtained from variable-head permeameter tests, and they are probably more reliable. It is suggested that consolidation test-data be used to supplement available permeability data and that consolidation tests are a virtually untapped source of permeability data available to hydrologists.—Authors' abstract

Seed, H. Bolton. *See* Goodman, R. E. 5811

Seed, H. Bolton. *See* Noorany, Iraj. 5838

5839 **Seed, H. Bolton; Goodman, Richard E.** Earthquake stability of slopes of cohesionless soils [reply to discussions of paper 4128, 1964]: Am. Soc. Civil Engineers Proc., v. 92, Jour. Soil Mechanics and Found. Div., no. SM3, p. 87–88, 1966.

The term "shear strength intercept" was used to avoid indicating any connection with "cohesion"; s_i is not intended as a fundamental parameter. In the low confining pressure shear tests, the area of contact was 72 sq in; no passive wedge formation was observed. Inherent difficulties in any method of measuring the angle of friction of a sand at low confining pressures would appear to make some degree of error inevitable; such errors of 1° or 2° can lead to large errors in computed dynamic displacements such as those by earthquakes.—G.D.C.

5840 **Selig, Franz; Wallick, George C.** Temperature distribution in salt domes and surrounding sediments: Geophysics, v. 31, no. 2, p. 346–361, illus., tables, 1966.

A straightforward mathematical procedure allows the calculation of the isogeothermal pattern in and about a salt intrusion. An axially symmetrical structure is chosen to illustrate the kind of inferences that can be drawn from temperature data, such as discrimination between connected and disconnected domes, and estimation of the vertical velocity of the intrusion. The numerical results confirm and extend observations in electrolytic scale models (Guyod, 1946) and augment Heroy's comments (1962) on the thermal properties of salt.—D.B.V.

5864 **Sellers, William D.** Physical climatology: Chicago, Ill., Univ. Chicago Press, 272 p., illus., tables, 1965.

In this textbook of meteorology, special emphasis is placed on the global energy and water balance regimes of the Earth and its atmosphere, and their relationships and interactions. A concluding chapter on paleoclimatology and theories of climatic change is to be read with the discussions of the radiation and energy balances in mind.—G.D.C.

SEPM. *See* Am. Assoc. Petroleum Geologists. 5732

Seward, Franklin A., Jr. *See* Heinrichs, Walter E., Jr. 5916

Shapiro, Leonard. *See* Grimaldi, F. S. 5903

Sharma, Bijon. *See* Geldart, L. P. 5841

5784 **Sharps, Joseph A.** Geologic map of the Load quadrangle, Greenup County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-519, scale 1:24,000, section, text, 1966.

The most important mineral resource in the Load quadrangle is refractory clay mined principally from pits in the Olive Hill Clay Bed within the basal 30 feet of the Pennsylvanian rocks. Coal has been produced locally from six or more beds. Newman Limestone, suitable for road metal, is more than 35 feet thick in one area and has potential value.—M.C.M.

5905 **Shawe, Daniel R.** Zonal distribution of elements in some uranium-vanadium roll and tabular ore bodies on the Colorado Plateau, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B169-B175, illus., tables, 1966.

Uranium, vanadium, and selenium are zonally distributed within and near some uranium-vanadium roll and tabular ore bodies in sandstone on the Colorado Plateau. The zones are concentric with the curved boundaries of the rolls, and parallel to the boundaries of tabular bodies. The zones are compatible with a theory that ore and other introduced elements were precipitated at an interface between two solutions with different properties, now represented by the ore boundary.—Author's abstract

5920 **Shepard, F. P.** Submarine canyons explored by Cousteau's diving saucer, *in* Submarine geology and geophysics—Colston Research Society Symposium, 17th, Bristol, England, 1965, Proc.: London, Butterworths, p. 303-309, illus., 1965.

Submarine canyons offshore from La Jolla, Calif., and Cape San Lucas, Baja California, have been explored to depths of 1,000 feet by the diving saucer. Scripps Canyon has vertical walls throughout its length, the floor of La Jolla Canyon is strewn with rockfall debris, and San Lucas Canyon has steep slopes and some vertical walls. Sediment on the floor at any one place may be swept clean and change character completely within a short period of time (weeks or months), that is, from organic debris to sand or mud and back again. Currents are variable but known to transport sand; turbidity currents are not necessary to explain sand or shallow-water organisms in deeper parts. Bathymetric charts of the canyons are included.—V.S.N.

Sherman, G. Donald. *See* Kanehiro, Yoshinori. 5661

5790 **Shurtz, R. F.** The mathematics of mine sampling: Soc. Mining Engineers Trans., v. 235, no. 1, p. 75-82, tables, 1966.

The problem of estimating the precision of systematic samples from a mineral deposit is attacked by interpolating the quality, or other attribute measured, by using Fourier approximation. Such approximation using trigonometric functions yields a particularly simple expression for the variance of the mean value of the attribute sampled.—Author's abstract

5667 **Simmons, Gene.** Heat flow in the Earth: Jour. Geol. Education, v. 14, no. 3, p. 105-110, illus., 1966.

World average heat flow is slightly higher than one heat flow unit, and the average beneath oceans is not very different from that beneath continents; locally heat flow may be as much as 10 or as little as zero HFU, and the values show remarkably small variations over some large areas. Sources of normal heat production beneath oceans must extend to greater depths because of the low radioactivity of oceanic crust. A representation of world heat flow data is given, and comparison made

with geoid heights above the spheroid. Heat flow is high where the geoid is depressed, which might support mantle convection. Measurement techniques are described, and geologic aspects of heat flow, and some remaining problems are discussed.—E.S.L.

5826 **Simon, J. A.; Hopkins, M. E.** Sedimentary structures and morphology of late Paleozoic sand bodies in southern Illinois—Am. Assoc. Petroleum Geologists, Semi-Centennial Convention, St. Louis, Mo., 1966, Field Guidebook: Illinois Geol. Survey Guidebook Ser. 7, 67 p., illus., tables, 1966.

Systematic studies of these variable bodies in the Illinois Basin have provided better understanding of their geologic history than for any comparable group of sandstones in the world. Chesterian and Pennsylvanian sandstones here are generally fine-grained, locally medium-grained as in the Caseyville Formation. Elongate bodies are slightly coarser grained than sheet sandstones, becoming finer-grained toward the top. Mineralogical differences, relatively slight laterally, are more marked vertically. Indicated sources are east of the Appalachian Basin and in the Canadian Shield. Some elongated bodies suggest dendritic deposition, some complex tributaries and distributaries, and some offshore. Photographs illustrate common sedimentary structures examined; locality descriptions are given in an appendix.—G.D.C.

5545 **Sinclair, Alastair James.** A lead isotope study of mineral deposits in the Kootenay arc [abs.]: Dissert. Abs., v. 26, no. 11, p. 6649-6650, 1966.

5551 **Singleton, Paul C.** Nature of interlayer material in silicate clays of selected Oregon soils [abs.]: Dissert. Abs., v. 26, no. 11, p. 6758-6759, 1966.

5627 **Siple, George E.** Salt-water encroachment of Tertiary limestones along coastal South Carolina [abs.]: South Carolina Div. Geology Geol. Notes, v. 9, no. 4, p. 57-58, 1966.

6017 **Skibitzke, Herbert E.** The use of analog computing in arid-zone hydrology, *in* Ecology of groundwater in the southwestern United States—Symposium, Arizona State Univ., 1961: Tempe, Ariz., Am. Assoc. Adv. Sci., Southwest and Rocky Mtn. Div., and Ariz. State Univ. Bur. Publications, p. 42-51, 1965.

Developments have progressed further on computer techniques for analyzing the problems of arid-zone ground water systems than for surface water systems. In arid regions the rate of ground water flow is very small; in the southwestern United States, in systems under development the flow is insignificant with respect to the total amount pumped in the region. Large-scale pumping over a period of 20 years has almost depleted ground water that has been stored over thousands of years. The effects of the total environment must be applied to hydrologic problems. Computer elements, with large resistence and capacitance networks, constructed by the U.S. Geological Survey, are being used in arid regions; by analogy the effect of electrical disturbances applied to a computer model can demonstrate what can be expected in development of an aquifer.—G.D.C.

5993 **Skjei, R. E.; Conwell, F. R.; Brittain, J. H.; Tabor, L. L.; Danehy, E. A.** Geologic site investigation for Stanford Linear Accelerator Center, Rept. ABA-88: [Palo Alto, Calif.] Aetron-Blume-Atkinson, 75 p., illus., tables, geol. maps, 1965.

This report supersedes previous preliminary geologic reports and presents a summary of pre-construction site investigations and records of the geological and seismological environment of the linear accelerator project—AEC Contract AT (04-3)-400—in the Sand Hill area west of Stanford University, Calif. Extremely stringent alignment requirements, together with the possibility of regional strain accumulation near the San Andreas fault, required that precise measurements of ground movement be included. A generalized geologic map of the area and bedrock sections are presented, and a series of detailed strip maps show the geologic structure. The subject headings of file data maintained by Aetron-Blume-Atkinson are listed in Appendix B.—G.D.C.

Sliter, William V. *See* Douglas, Robert. 5986

Smith, C. W. *See* Meuschke, J. L. 5602

Smith, D. L. *See* Ketner, K. B. 5859

Smith, F. C. *See* Blanchett, Jean. 5599

Smith, F. C. *See* Blanchett, Jean. 5600

5975 **Smith, Frederick Gordon.** Geological data processing—Using FORTRAN IV: New York, Harper and Row, 284 p., illus., tables, 1966.

FORTRAN (formula translation) IV language is explained in Chap. 12, and the author suggests reading this first. The rest of the subject matter is covered in chapters on symbolic logic, Boolean algebra, arithmetic, algebra (modern but simplified), vectors and matrices, calculus of discrete and continuous functions, probability, statistics, error–precision–accuracy, and flow diagrams. Most of these conclude with a set of problems, and the final chapter gives examples of data processing, many in geological research. A reference list is included.—E.S.L.

Smith, J. Y. *See* Edmonton Geological Society. 5817

5804 **Smith, R. M.; Twiss, Page C.** Extensive gaging of dust deposition rates: Kansas Acad. Sci. Trans., v. 68, no. 2, p. 311–321, illus., tables, 1965.

Dust was trapped continuously for a year, simultaneously at widely separated sites, by means of the outer cylinders of standard Weather Bureau gages. Information about monthly deposits at two sites in Kansas is given in tables, and the mineralogy of the dust trapped is described. Specific sites or regions may be characterized by a basal rate of influx providing a lower bound from which increased rates may be measured. Quantities of influx over long periods are great enough to be of scientific interest.—E.S.L.

Snelling, N. J. *See* Deans, T. 5746

Soc. Econ. Geologists. *See* Am. Assoc. Petroleum Geologists. 5732

Spackman, William. *See* Habib, Daniel. 5899

5656 **Specht, Alston W.; Myers, Alfred T.; Oda, Uteana.** Elemental analysis by optical emission spectrography, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 822–848, illus., tables, 1965.

Principles involved in optical emission spectroscopy are set forth, and the instrumentation described. Full descriptions are given of methods for elemental analysis of soil extracts and total analysis. Comments and tables of data are given for each. A brief description is given of a semiquantitative method.—E.S.L.

5885 **Speckels, Milton L.** The complete guide to micromounts—A manual for mineral collectors . . .: Mentone, Calif., Gembooks, 97 p., illus., 1965.

This manual with data on selection, mounting, care and display of minerals includes information on commercial products, equipment, materials, instruments, and techniques for the beginner as well as advanced micromounter, and on preparation for shipping. There are many ways to create micromount collections, but only the traditional and currently accepted methods are included.—G.D.C.

5943 **Staatz, Mortimer H.; Conklin, Nancy M.** Rare-earth thorium carbonate veins of the Road Gulch area, northern Wet Mountains, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B130–B134, illus., 1966.

Carbonate veins containing four rare earth bearing minerals—monazite, bastnaesite, thorite, and fergusonite—occur along a northeast-trending shear zone

that extends for a distance of 1,560 feet. This shear zone lies 1.4 miles west of the large alkalic intrusive complex centered around McClure Mountain. The veins differ from most of the thorium-bearing veins southeast of the alkalic complex in having principally a gangue of carbonate rather than quartz, and in having a content of rare earths exceeding that of thorium. The chemical and physical character of these veins indicate that they should be classed as carbonates.—Authors' abstract

5546 **Stauffer, Peter Hermann.** Sedimentation of lower Tertiary marine deposits, Santa Ynez Mountains, California [abs.]: Dissert. Abs., v. 26, no. 11, p. 6650, 1966.

5833 **Stebbins, G. Ledyard.** Processes of organic evolution: Englewood Cliffs, N. J., Prentice-Hall, 191 p., illus., tables, 1966.

As the second century begins since publication of the *Origin of Species*, conflicting theories of evolution have been sifted and combined to produce a synthesis upon which evolutionists in all disciplines of biology—taxonomy, genetics, cytology, ecology, and paleontology—are beginning to agree. This synthesis is offered here to students who have had some training in biology and have mastered the basic principles and vocabulary of Mendelian genetics. Two of the chapters deal with major trends of evolution including the fossil record and dating of fossils and the fossil record of man.—G.D.C.

5896 **Steinbrugge, Karl V.; Bush, Vincent R.** Review of earthquake damage in the western United States, 1933–1964, *in* Earthquake investigations in the western United States, 1931–64: U.S. Coast and Geod. Survey Pub. 41-2, p. 223–256, illus., tables, 1965.

A survey of damage to buildings caused by earthquakes, beginning with the Long Beach, Calif., earthquake of 1933 through the Alaskan earthquake of 1964, indicates that the distance a structure is located from a fault on which an earthquake occurs is not as important as proper earthquake-resistant design of foundations and superstructure. Recent damage observations seem to confirm that intensity adjoining the fault's surface trace is not significantly different from that several miles away provided geologic conditions are reasonably uniform and fault dip reasonably vertical. Long-period ground motion has been particularly destructive to multistory structures and disturbing to fluids in large tanks; low, rigid buildings have performed relatively well. Monolithic poured-in-place reinforced concrete has been satisfactory construction material in multistory buildings. In all types of building, however, workmanship and good construction are critical.—V.S.N.

5946 **Stern, T. W.; Newell, M. F.; Hunt, C. B.** Uranium-lead and potassium-argon ages of parts of the Amargosa thrust complex, Death Valley, California, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B142–B147, illus., tables, 1966.

Zircon from Precambrian augen gneiss in the Amargosa thrust lower plate has a Pb-207/Pb-206 age of 1,820 m.y. Feldspar from Tertiary quartz monzonite and monzonite porphyry intrusives has yielded a K-Ar age of 12 to 14 m.y. Biotite in Precambrian augen gneiss has a K-Ar age of 11 to 14 m.y. and reflects reheating associated with emplacement of younger intrusions and volcanic rocks. Pb-α ages of zircon in igneous rocks are also Tertiary but have a large probable error compared to the calculated age. Determined ages agree well with stratigraphic and structural relationships determined by field geologic mapping. However, ages are inconclusive in establishing whether igneous rocks were derived by melting of Precambrian rocks and to what extent volcanic rocks were derived by differentiation of intrusions that breached their roofs.—*from* Authors' abstract

5552 **Stevenson, Ralph Girard, Jr.** Mineralogy, petrology, and geochemistry of a complex mineral association near Pony, southwestern Montana [abs.]: Dissert. Abs., v. 26, no. 11, p. 6759, 1966.

5786 **Stewart, G. L.; Hoffman, C. M.** Tritium rainout over the United States in 1962 and 1963: U.S. Geol. Survey Circ. 520, 11 p., illus., tables, 1966.

This report describes the tritium sampling network established by the U.S. Geological Survey. Tritium rainout data are included for 1962 and 1963 precipitation collected at 15 stations in the United States and Puerto Rico. Data are presented graphically to show seasonal variations and geographic distribution patterns for 1963; total during 1963 was considerably higher than it was in previous years. Peak tritium concentrations in late spring or early summer of 1963 were higher by a factor of three or more over concentrations measured in 1962.—*from* Authors' abstract

Stewart, J. H. *See* Burchfiel, B. C. 5754

5793 **Stillwell, H. D.** [Glaciation] *in* Anatomy of a watershed, Red Cedar River, Michigan: East Lansing, Mich., Michigan State Univ., Dept. Resource Devel., p. 36–38, illus. [1966].

The Charlotte, Lansing, and Grand Ledge moraines, and Mason and other eskers, are described. Consequent streams reflect the northern dip of the bedrock, but the Red Cedar River flows east–west, showing the influence of the receding glacier. A sketch map shows these features.—E.S.L.

5547 **Stingelin, Ronald Werner.** Late-glacial and post-glacial vegetational history in the north central Appalachian region [abs.]: Dissert. Abs., v. 26, no. 11, p. 6650, 1966.

Stotelmeyer, R. B. *See* Mallory, W. W. 5628

5898 **Stovas, M. V.** O kharaktere sovremennykh vertikal'nykh dvizheniy Severnoy Ameriki [with English summ.]: Akad. Nauk Ukrain. SSR Mezhduvedomstv. Geofiz. Kom. Inf. Byull. Geofizika i Astronomiya, no. 8, p. 56–61, 1965.

The northern coast of North America is being uplifted at a rate of 2 to 20 mm per yr, the same as Greenland and the Chukot Peninsula. The southern Atlantic and Pacific coasts are subsiding at a rate of 4 to 6 mm per yr, and the Gulf Coast at rates up to 15 mm per yr (at Galveston). The line of zero uplift passes about through Seattle, the north shore of the Great Lakes, and Newfoundland. The vertical movements are inherited in character, and complicated by the glacioeustatic factor; they probably reflect changes in the ellipticity of the Earth.—D.B.V.

5978 **Strand, Rudolph G.; Koenig, James B.** (compilers). Geologic map of California, Olaf P. Jenkins edition—Sacramento sheet: San Francisco, California Div. Mines and Geology, scale 1:250,000, separate explanatory data sheet, 1965.

The data sheet includes the index to geologic mapping used in the compilation of the Sacramento sheet and a stratigraphic nomenclature chart.—M.C.M.

5742 **Summers, W. K.** Chemical characteristics of New Mexico's thermal waters—A critique: New Mexico Bur. Mines and Mineral Resources Circ. 83, 27 p., illus., tables, 1965.

In New Mexico spring and well waters with temperatures of 90°F or greater, located along faults and generally related to nearby igneous rocks of Tertiary or Quaternary age, are sodium-rich with chloride, sulfate, and tricarbonate in varying ratios. Fluoride concentrations are higher than in nonthermal waters. Chemical analyses from Sulphur Springs show many inconsistencies among which are unusual concentrations of boron at Soda Dam Springs and Jemez Springs, and of radium at Faywood Hot Springs. At Truth-or-Consequences sodium-chloride waters from springs and wells are amazingly uniform. Variabilities are noted in travertine terraces, uniformity in discharge and temperature, circulation to shallow or great depths. Some are warmed meteoric waters, others may be partly juvenile. Many questions relating to the hydrothermal process remain unanswered.—G.D.C.

Surdam, Ronald C. *See* Hall, Clarence A. 5755

5654 **Sutton, G. H.; McDonald, W. G.; Prentiss, D. D.; Thanos, S. N.** Ocean-bottom seismic observatories: IEEE Proc., v. 53, no. 12, p. 1909–1921, illus., 1965.

Instrument systems consisting of long- and short-period seismographs, long- and short-period pressure sensors, a temperature sensor, and water-current sensor were operated on the ocean bottom. Experience and calculation indicate that these systems can be well coupled to the sediment surface, mechanically stable, and relatively insensitive to water currents. Local and distant earthquakes, tides, microseisms, long-period pressure disturbances, and temperature fluctuations have been well recorded from the ocean bottom at depths greater than 2,000 fm. Instrument systems were implanted at two locations—south of Bermuda and west of San Francisco. Data were telemetered acoustically to ship and via deep-sea cable to a shore station.—*from* Authors' abstract

5856 **Suzuki, Yoshio.** On the trend surface analysis [in Japanese with English abs.]: Butsuri-Tanko, v. 18, no. 3, p. 18–26, illus., tables, 1965.

Trend surface analysis by use of the regression analysis method is discussed and applied to analysis of variation in mineral composition within intrusive granitic bodies of the Port Clyde Peninsula, Maine, Kitakami Mountains, Japan, and Inzan, Korea. Calculations are given for a polynomial equation for use in analysis of irregularly spaced data. The significance of the trend surface is examined by variance analysis, and the almost significant surface is estimated for each component as a second order surface or plane. The second order surface may be significant in the internal compositional variation of intrusive granite bodies. Temperature distribution within a single body may be considered as a second order shape, in which case the more fluid components in a viscous granitic material will be concentrated in the less compressed part of the intrusion. Port Clyde data are tabulated.—V.S.N.

Swain, R. J. *See* Forbes, C. B. 5679

Swarzenski, W. V. *See* Lusczynski, N. J. 5556

5968 **Swoboda, A. R.; Kunze, G. W.** Infrared techniques for studying the adsorption of volatile vapors of clays: Soil Sci., v. 101, no. 5, p. 373–377, illus., 1966.

The writers have prepared very durable clay films which have proven to be highly satisfactory for organic-adsorption studies by infrared. The technique is presented whereby patterns and adsorption or desorption isotherms may be obtained simultaneously for volatile vapors adsorbed by clay. Details of the apparatus design and sample preparation techniques are discussed.—J.W.H.

Tabor, L. L. *See* Skjei, R. E. 5993

Tagg, A. Richard. *See* Uchupi, Elazar. 5851

5939 **Tagg, A. Richard; Uchupi, Elazar.** Distribution and geologic structure of Triassic rocks in the Bay of Fundy and the northeastern part of the Gulf of Maine, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B95–B98, illus., 1966.

Results of a seismic survey made of the Bay of Fundy and the northeastern part of the Gulf of Maine, using a continuous seismic profiler with sparker sound source, indicate that the Acadian Triassic basin extends westward beyond the Bay of Fundy for a distance of 120 km. Reflecting horizons which may represent bedding planes have dips of about 5° to 10° and generally dip away from basement highs. No evidence of a marginal fault was found along the northwest side of the basin. Authors' abstract

5586 **Tan, Li-Ping.** The New York pegmatite deposits [abs.]: Dissert. Abs., v. 26, no. 10, p. 5978–5979, 1966.

5725 **Tangborn, Wendell V.** Glacier mass budget measurements by hydrologic means: Water Resources Research, v. 2, no. 1, p. 105–110, illus., table, 1966.

Ice storage changes for the South Cascade Glacier drainage basin in Washington were determined for the 1957–1964 period using basin runoff and precipitation

measurements. Runoff averaged 4.04 m per yr, precipitation, 3.82 m per yr, resulting in a basin net loss of about 0.22 m per yr. During the same period net budgets were determined, and the average was found to be in fair agreement with the measured net storage change. Agreement between the two methods is slightly less perfect for individual years.—E.S.L.

5803 **Tasch, Paul.** Communications theory and the fossil record of invertebrates: Kansas Acad. Sci. Trans., v. 68, no. 2, p. 322–329, illus., 1965.

A theoretical approach is discussed, attempting qualitative exploration of answers to two questions: Is it possible to apply some of the essential concepts of modern communications theory to the fossil record of vertebrates, and in what way can these concepts, if they can be applied, be productive of new consequences? Some essential principles and definitions are given, illustrated by diagrams of feedback loops, and followed by a discussion of information and negative entropy. Seven possible new consequences inherent in the data retrieval approach are listed.—E.S.L.

Taylor, A. M. *See* Flanigen, E. M. 5810

5955 **Taylor, John K.; Maienthal, E. June; Marinenko, George.** Electrochemical methods, Chap. 10 *in* Trace analysis, physical methods: New York, Interscience Publishers, p. 377–433, illus., tables, 1965.

Electroanalytical techniques are especially attractive for trace element determinations. Many depend upon the concentration rather than the absolute quantity of material available; the limits of detection can easily extend into the nanogram range. The discovery of the principles of polarography in 1922 generated world-wide interest in electroanalytical chemistry which has fostered the development of the more than 20 techniques known today. The major emphasis in this chapter involves quantitative interpretation of electrical measurements. Their high precision and the ready availability of standards are distinct assets. General application to a wide variety of materials requires a good understanding of chemistry.—G.D.C.

5800 **Taylor, Ronald S.** Review of the general description in ostracode taxonomy: Kansas Acad. Sci. Trans., v. 68, no. 3, p. 443–456, 1965.

Original descriptions from a variety of ostracode publications, systematic descriptions in the Treatise on Invertebrate Paleontology, Part Q, and Hartmann's work on ostracode systematics at the suprageneric levels were studied, and the arrangement of the morphological characters was analyzed and their total terminology compiled, grouped in appropriate categories, and evaluated. A plan toward standardizing carapace descriptions was designed, based on a logical sequence of characters. This standardized sequence of characters and applicable terminology is presented in outline form.—E.S.L.

Taylor, Sterling A. *See* Jackson, Ray D. 5670

5548 **Taylor, Vernon A.** An experimental study of some replacement processes [abs.]: Dissert. Abs., v. 26, no. 11, p. 6651, 1966.

Terasmae, J. *See* Dreimanis, A. 5966

Thanos, S. N. *See* Sutton, G. H. 5654

Thatcher, L. L. - *ee* Payne, B. R. 5848

6024 **Thomas, M. P.** Effect of glacial geology upon the time distribution of streamflow in eastern and southern Connecticut, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B209–B212, illus., table, 1966.

In eastern and southern Connecticut the type and relative extent of glacial drift within a given area exert a predominant influence upon the runoff characteristics of streams draining the area. Flow-duration curves were studied for the period 1931–60, for streams in areas where the drift consists entirely of till, entirely of

stratified drift, or partly of each; the average streamflow is 1.80 cfs per sq mi. These curves show that the median annual minimum 7-day average flow (which in Connecticut is equivalent to the streamflow equaled or exceeded about 94 percent of the time) is 1.30 cfs per sq mi from a drainage area underlain exclusively by stratified drift, and only 0.013 cfs per sq mi from an area underlain exclusively by till, a ratio of 100 to 1.—Author's abstract

6026 **Thompson, Thomas L.** Late Meramecian conodont faunas from the Fort Bellefontaine and Vigus North Quarries, St. Louis County, Missouri, *in* Guidebook to Middle Ordovician and Mississippian strata, . . . —Am. Assoc. Petroleum Geologists, 1966 Ann. Mtg.: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 34, p. 42–48, illus., tables, 1966.

One sample was collected from each recognizable bed within the Mississippian Salem–Ste. Genevieve succession. Characteristics of conodonts recovered are described and their distribution shown. Assemblage zones are compared with those in Madison County, Ill., and the biostratigraphic boundaries with those obtained by insoluble residues and field stratigraphy.—E.S.L.

Tipper, H. W. *See* Campbell, R. B. 5980

5835 **Toomey, Donald F.** Application of factor analysis to a facies study of the Leavenworth Limestone (Pennsylvanian–Virgilian) of Kansas and environs: Kansas Geol. Survey Spec. Distrib. Pub. 27, 28 p., illus., tables, 1966.

The lateral persistence and uniformity of this Member of the Oread Limestone has long been known. Vector analysis of samples from 32 outcrops from southwestern Iowa to northern Oklahoma have delineated three meaningful facies: a dominant skeletal mudstone characterized by diverse skeletal grains, an aggregate-grain facies with large complex coated grains, and a mudstone facies with high percentage of lime mud and reduction of organic constituents. In total foram counts three biofacies were defined: mobile smaller Foraminifera, fusulinids dominantly tricitid, and an encrusting biofacies of three genera. The Leavenworth Limestone is believed to have been deposited in relatively shallow water on a broad, slowly subsiding platform; its lateral homogeneity results from a coincidence of the outcrop belt with depositional strike.—G.D.C.

5802 **Trapp, Harold R.** Laboratory subaqueous pseudo–volcanoes: Kansas Acad. Sci. Trans., v. 68, no. 2, p. 330–335, illus., 1965.

A subaqueous pseudovolcano about four centimeters high was created by accident in a beaker in which disaggregated Ireland Sandstone was being processed. An experiment was then performed with the same sandstone in three beakers containing, respectively, distilled water, sea water, and distilled water with HCl. When the sediment settled, a silt and clay layer rested on a layer of coarser sand. A bump would cause pseudovolcanoes to form in all the beakers. Water migrated upward from the sand layer and accumulated under the silt layer until it bulged and buckled and pseudovolcanic necks formed.—E.S.L.

Troxel, Bennie W. *See* Hill, Mason L. 5753

5557 **Tsukada, Matsuo.** The pollen sequence, *in* The history of Laguna de Petenxil, a small lake in northern Guatemala: Connecticut Acad. Arts and Sci. Mem., v. 17, p. 63–66, illus., 1966.

Pollen taken at 5 cm levels from two cores of Laguna de Petenxil sediments was prepared by the acetolysis method. Three zones are shown indicating a change from grassland to forest and providing evidence of the presence of agricultural man from 4,000 B.P. to the present. Pollen diagrams are included.—E.S.L.

5891 **Turcan, A. N., Jr.** Calculation of water quality from electrical logs—Theory and practice: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 19, 23 p., illus., tables, 1966.

Estimate of concentration of some ions in water in an aquifer can be made from electrical-logging data by use of the formula $R_o/R_w = F_f$, where R_o is resistivity reading from long-normal curve on electrical log, R_w is resistivity of water in formation, and F_f is field formation resistivity factor. After determining R_w, specific conductance can be computed and dissolved solids in water in the formation can be estimated from an empirical formula determined from a plot for all major aquifers in Louisiana. If water type and porosity of the aquifer do not change significantly, F_f can be used for quantitative determinations over a large region. In Arkansas, Mississippi, and northern Louisiana, where predominant type of water in Sparta Sand is sodium bicarbonate, $F_f = 3.5$ is applicable.—M.C.M.

5832 **Turekian, Karl K.** The meteorite and tektite collections of Yale University: Postilla, no. 101, 16 p., table, 1966.

The last catalog of the meteorite collections at Yale University was made by Servos (1956) and included the Peabody Museum Collection and the Bosch Collection; the latter was transferred to the U.S. National Museum in 1966. The total number of different falls and finds now in the Peabody Collection is 314. The alphabetical tabulation of meteorites and tektites includes name and locality, date of fall or find, class, catalog number, and weight in grams. In the list of meteorites according to class, the combined weights of all specimens for each meteorite in the collection are given in grams.—M.C.M.

Turner, Daniel S. *See* Ball, Max W. 5816

Turner, Donald L. *See* Hall, Clarence A. 5755

Turner, F. J. *See* Essene, E. J. 5971

Twiss, Page C. *See* Lanning, F. C. 5801

Twiss, Page C. *See* Smith, R. M. 5804

5851 **Uchupi, Elazar; Tagg, A. Richard.** Microrelief of the continental margin south of Cape Lookout, North Carolina: Geol. Soc. America Bull., v. 77, no. 4, p. 427–430, illus., 1966.

On the basis of microrelief data, the continental margin between Cape Lookout, N. C., and the Bahama Islands is divided into four domains: smooth, undulating, rough, and blocky.—A.G.

Uchupi, Elazar. *See* Emery, K. O. 5866

Uchupi, Elazar. *See* Tagg, A. Richard. 5939

5611 **Ulrich, George E.** Geologic map of the Olmstead quadrangle, Todd and Logan Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-553, scale 1:24,000, section, text, 1966.

Limestone quarried from Paint Creek, Renault and Ste. Genevieve Limestones in the Olmstead quadrangle has been used for road material and agricultural lime. Minor shows of oil and gas have been reported, mostly between 0–110 feet below the Chattanooga Shale; the lower part of Big Clifty Sandstone Member of Golconda Formation has possible value as molding or construction sand; and ground water, perhaps the most valuable resource, is obtained from above shale beds at the base of the Golconda and in the Cypress Formations.—M.C.M.

Untersteiner, N. *See* Cabaniss, G. H. 5698

5663 **U.S. Geological Survey.** (Visual Services Staff). The U.S. Geological Survey's popular publications: Jour. Geol. Education, v. 14, no. 3, p. 87–88, 1966.

The Geological Survey has introduced a series of free publications as an aid in providing public information. The leaflets cover basic topics in geology, water resources, and geologic and topographic mapping, and describe some of the Survey's

activities. The vocabulary is geared to lay readers ranging widely in age and background. The 14 leaflets produced to date, and those in preparation, are described.—E.S.L.

5637 **Vaasjoki, O.** Mackinawiitin termisistä ominaisuuksista [with English abs.]: Geologi, v. 18, no. 6, p. 85–86, 1966.

A study program on sulfide mineralization has been carried out using a Reichert microscope heating table. Attention was given to the transformation of mackinawite present in pentlandite-bearing rocks from Finland. Results obtained support the opinion that mackinawite might have originated by selective replacement as proposed for the mackinawite-bearing mineralization in the Muskox intrusion, Northwest Territories.—*from* Author's English abstract

5655 **VandenHeuvel, R. C.** Elemental analysis by X-ray emission spectrography, *in* Methods of soil analysis—Pt. 2, Chemical and microbiological properties: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 771–821, illus., tables, 1965.

The excitation and measurement of fluorescent X-rays is explained and the effect of matrix and particle size described. Quantitative techniques vary according to elements desired, matrix, and degree of precision required. The classic method is the use of internal standards. Variations of this are described, and the fusion technique is discussed in detail, including calculation of mass absorption coefficients, with tables.—E.S.L.

5982 **VanDorn, W. E.** Tsunamis, *in* Advances in hydroscience, V. 2: New York, Academic Press, p. 1–48, illus., tables, 1965.

This paper discusses the nature and observation of tsunamis. Following a brief introduction, hydrodynamics of centered wave systems; methods of field measurement and model studies; a case history of a tsunami (Alaskan earthquake, 1964); and applications (prediction, warning, and design considerations) are examined.—V.S.N.

5987 **vanEverdingen, R. O.** Use of pressure transducers for the determination of piezometric pressures in confined aquifers under the South Saskatchewan Reservoir, Canada: Jour. Hydrology, v. 4, no. 1, p. 70–78, illus., tables, 1966.

The South Saskatchewan Reservoir will be about 140 mi long and water at the dam will be 192 feet deep. Bedrock underlying the reservoir consists of alternating shales and sandstones of the Cretaceous Bearpaw and Belly River Formations. The sandstones form aquifers in which the piezometric head will increase as the reservoir fills. The stability of the dam could be affected because the high pressures would not be counteracted on the downstream side. Piezometers were installed in the sandstone beds and transducers put on those flooded. Detailed descriptions and illustrations of this installation are given and the calibration discussed. Hydrographs are included and preliminary results tabulated.—E.S.L.

5915 **vanHylckama, T. E. A.** Natural recharge of groundwater, *in* Ecology of groundwater in the southwestern United States—Symposium, Arizona State Univ., 1961: Tempe, Ariz., Am. Assoc. Adv. Sci., Southwest and Rocky Mtn. Div., and Ariz. State Univ. Bur. Publications, p. 28–41, illus., 1965.

In arid climates, everywhere in the hydrologic cycle, processes tend to prevent recharge and use of ground water at a rate higher than its natural recharge results in the lowering of the water table. Interest in transpiration and growth of riparian vegetation has led to studying effects of eradication of phreatophytes on the water table, and then to what plants could be substituted with benefit to recharge. The increasing growth of population in the desert areas and demands of industrial and domestic users of water emphasize the importance of hydrologic and agricultural research.—G.D.C.

5818 **Vanlier, Kenneth E.** Ground-water resources of the Battle Creek area, Michigan: Michigan Geol. Survey Water Inv. 4, 50 p., illus., tables, 1966.

The two sources of ground water in the Battle Creek area are the Marshall Formation and glacial drift. Wells tapping the Marshall produce most of the water used in the area. Glacial deposits, mainly permeable sand and gravel, are not extensively used for water supply, except in the southwest part of the area where sandstone is not present. Water from both aquifers is hard to very hard and locally contains excessive amounts of iron. Water level data indicate that ground-water withdrawals can be increased three to four times before decline in levels becomes serious.—*from* Author's abstract

5880 **VanNostrand, Robert G.; Cook, Kenneth L.** Interpretation of resistivity data: U.S. Geol. Survey Prof. Paper 499, 310 p., illus., tables, 1966.

Results are given of a systematic study of interpretation of resistivity data, begun during surveying in the Tri-State zinc and lead mining district in 1951. The purpose of the study was to develop in English under a single cover the subject of direct-current electrical prospecting both as a text for students and as a reference for advanced workers, to present the theory necessary to solve problems in electrical prospecting and a wealth of theoretical resistivity curves based on this treatment, to show how theoretical results and curves can be used to interpret field data, to compare present field techniques in the light of these curves and data and to devise additional techniques, and to assemble a comprehensive bibliography on the subject of surface-resistivity methods.—V.S.N.

Vargo, J. L. *See* Blanchett, Jean. 5597

Vargo J. L. *See* Blanchett, Jean. 5598

Vargo, J. L. *See* Mitchell, C. M. 5603

Vecchioli, John. *See* Seaber, Paul R. 5951

Veith, K. F. *See* Marovelli, R. L. 5791

5561 **Venuto, Louis John.** Dean Edward Steidle's contributions to the growth of the College of Mineral Industries at the Pennsylvania State University—A case study [abs.]: Dissert. Abs., v. 26, no. 11, p. 6499-6500, 1966.

5696 **Vine, James D.** Element distribution in some shelf and eugeosynclinal black shales: U.S. Geol. Survey Bull. 1214-E, p. E1-E31, illus., tables, 1966.

Emission spectrographic analyses of 220 samples of black shale from Pennsylvanian rocks of the shelf area in the Eastern Interior coal province and from Ordovician and Silurian rocks of the western North America eugeosyncline have been compared. Some samples of both the shelf group and the eugeosynclinal group have high contents of vanadium, chromium, zinc, silver, and moderately high contents of nickel and copper. High molybdenum and nickel contents are characteristic of the samples from the shelf; high barium content is characteristic of the samples from the eugeosyncline.—Author's abstract

5695 **Vlisidis, Angelina C.** The determination of sulfate and sulfide sulfur in rocks or minerals: U.S. Geol. Survey Bull. 1214-D, p. D1-D5, table, 1966.

This paper presents a method in which sulfate sulfur is converted to barium sulfate. An inert atmosphere is maintained to prevent oxidation of any sulfide sulfur. Cadmium chloride is added to precipitate any sulfide ion that may be liberated. The sulfate sulfur is then measured by the determination of barium on the barium sulfate precipitate and is therefore unaffected by any subsequent oxidation of the sulfide sulfur. Total sulfur is determined on a separate sample and sulfide sulfur is calculated by difference.—A.C.V.

5843 **Voskuil, Walter H.** Selected readings in mineral economics: Nevada Bur. Mines Rept. 12, 18 p., 1966.

This list of references is comprised of contributions which Voskuil has found useful as supplementary readings for student and teacher in courses in mineral economics,

mining, and geology. Most publications cited are of recent date, but earlier ones are included for standard background reading. The bibliography contains general references on mineral resources; fuels, iron ore, gold and silver, and nonferrous metals; construction, chemical, and miscellaneous minerals; taxation, valuation, marketing; and U.S. government publications.—M.C.M.

5836 **Waddell, Dwight E.** Pennsylvanian fusulinid biozones in southern Oklahoma: Oklahoma Geology Notes, v. 26, no. 5, p. 123–133, illus., 1966.

On the basis of a detailed study of 2,000 fusulinid thin sections from more than 60 geographic localities throughout the Ardmore basin area and within the Mill Creek graben, the Pennsylvanian is divided into seven biozones, in hopes that they may be useful in subsurface correlation. The lowest zone, late Atokan in age, is marked by *Fusulinella*; the only named rock unit is the Bostwick Member. Several genera of Desmoinesian age characterize the next four zones, in which numerous named rock units of variable lithology are difficult to identify. The last two zones, marked by *Triticites* of Missourian age, are more easily identified because of the degree and rapidity of morphologic changes. The various fusulinid species are illustrated.—G.D.C.

Wahrhaftig, Clyde. *See* Croft, M. G. 5715

5717 **Wahrhaftig, Clyde.** Stepped topography of the Sierra Nevada, *in* Guidebook for Field Conference I, Northern Great Basin and California—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 123–128, illus., 1965.

From the Tuolumne River south, the western granite slope of the Sierra Nevada descends by irregular giant steps to the San Joaquin Valley. Their bare fronts are from 100 to several feet high; their treads, from several hundred feet to a few miles broad, are commonly underlain by gruss 100 feet thick in places. The explanation offered here is that granite weathers more rapidly to gruss where kept moist by burial than where exposed as solid outcrops which dry shortly after rain. With lateral growth the exposures may coalesce to form lines which later become escarpments. The mineral chiefly responsible for the gruss is biotite which alters to expandable clay. Alternate explanations of faults or retreating escarpments are disproved.—G.D.C.

5962 **Walitzi, Eva Maria.** Die Kristallstruktur von Denningit, $(Mn,Ca,Zn)Te_2O_5$—Ein Beispiel für die Koordination um vierwertiges Tellur [with English abs.]: Tschermaks Mineralog. u. Petrog. Mitt., ser. 3, v. 10, nos. 1–4, p. 241–255, illus., tables, 1965.

Denningite (Moctezuma, Sonora, Mexico) is tetragonal with space group $P\ 4_2/n\ bc$ and unit-cell dimensions $a=8.82$, $c=13.04$ Å; $Z=8$. The structure has been determined and refined by Patterson, Fourier, and (F_o-F_c) projections, and a least-squares refinement has been carried out. Pairs of trigonal TeO_3 pyramids are connected to isolated Te_2O_5 groups. Mn, Ca, and Zn in eight coordination and in [4+2] coordination form chains along [001] connected by Te_2O_5 groups.—E.S.L.

5697 **Walker, George W.; Greene, Robert C.; Pattee, Eldon C.** Mineral resources of the Mount Jefferson primitive area, Oregon: U.S. Geol. Survey Bull. 1230-D, p. D1–D32, illus., table, geol. map, 1966.

The Mount Jefferson primitive area in the Oregon Cascade Range is part of a north-trending volcanic plateau surmounted by several large, steep-sided, extinct or possibly dormant, volcanoes. Rocks include a series of flows, breccias and sedimentary rocks, and a younger series of flows and pyroclastic deposits, the first correlative with volcanic rocks of the Western Cascade Range and the second with those of the High Cascades. Extrusive rocks are cut by dikes and plugs. Several areas are weakly mineralized with alunite and native sulfur in minimal amounts; analyses of samples and stream sediments indicate no metallic mineral or metal concentrations of value. Neither the small scattered deposits of windblown pumice or the widely distributed cinders are economically suitable for exploitation. None

of the many springs in the area have temperatures suitable for production of thermal power.—*from* Authors' abstract

Wallick, George C. *See* Selig, Franz. 5840

5692 **Wanek, Alexander A.; Barclay, C. S. Venable.** Geology of the northwest quarter of the Anaconda quadrangle, Deer Lodge County, Montana: U.S. Geol. Survey Bull. 1222-B, p. B1-B28, illus., geol. map, 1966.

Precambrian, Cambrian, Mississippian, Pennsylvanian, Cretaceous, Tertiary, and Quaternary rocks are exposed in the Anaconda quadrangle; other units present in the subsurface are missing at the surface because of the faulting. Eocene rocks form a threefold volcanic sequence correlated with Lowland Creek Volcanics exposed near Butte. Glacial moraine, colluvium and landslide deposits, and alluvium and terrace gravel also are present. In the northwest, Precambrian and Paleozoic rocks are thrust faulted against Mesozoic strata, and intruded by granite along zones of faulting. Major deformation occurred in Late Cretaceous or early Tertiary, with minor deformation during Eocene, Miocene(?) and Pliocene. Granitic intrusions were concurrent with thrusting.—M.C.M.

5796 **Wanless, Harold R.** Aerial stereo photographs: Northbrook, Ill., T. N. Hubbard Sci. Co., 92 p., illus., 1965.

The 92 sets of photographs illustrate wind action, ground water, mass movements, glaciation, several types of landforms, stream erosion and deposition, volcanic features, lithology, rock structure, sequential coastal studies, vegetation, mining, and cultural features. An introduction explains airphotos and their use, and a brief text describes each stereogram.—E.S.L.

Ward, F. N. *See* Hinkle, Margaret. 5944

5749 **Wardlaw, N. C.; Schwerdtner, W. M.** Halite-anhydrite seasonal layers in the Middle Devonian Prairie Evaporite Formation, Saskatchewan, Canada: Geol. Soc. America Bull., v. 77, no. 4, p. 331-342, illus., 1966.

In the lower half of the Devonian Prairie Evaporite Formation, halite units alternate with anhydrite units, thought to have resulted from seasonal changes during deposition and called seasonal layers. Halite grains conspicuously elongated perpendicular to bedding contain a distinctive chevron structure caused by zones of liquid inclusions and are considered to be primary and to have grown on the Devonian sea floor. Bromide analyses of successive chevron grains above an anhydrite layer show a rapid increase to a maximum value and then a steady decrease as the overlying anhydrite layer is approached; this is most satisfactorily explained by influxes of sea water or brine.—E.H.L.

5964 **Wardlaw, N. C.; Watson, D. W.** Middle Devonian salt formations and their bromide content, Elk Point area, Alberta: Canadian Jour. Earth Sci., v. 3, no. 3, p. 263-275, illus., 1966.

The Prairie Evaporite Formation contains three types of halite: chevron, clear and brown. Where they occur together, the clear halite has more bromide than the other two. The total range for bromide from this formation is 0.004-0.02 wt percent. The lower salts, Cold Lake and Lotsberg Formations, consist of clear halite so low in bromide that it could not have crystallized from sea water. Probably these salts resulted from solution of halite in fresh water, with subsequent crystallization. Ground water in Devonian formations of central Alberta, and spring waters from Devonian formations in Manitoba, are saline and carry 0.001-0.10 wt percent bromine. Either these brines are modified remnants of sea water, or there is some undefined source of bromine.—E.S.L.

Wark, J. W. *See* George, J. R. 5949

Watson, D. W. *See* Wardlaw, N. C. 5964

Watson, R. J. *See* Levin, F. K. 5972

5683 **Watts, W. A.; Wright, H. E., Jr.** Late-Wisconsin pollen and seed analysis from the Nebraska Sandhills: Ecology, v. 47, no. 2, p. 202–210, illus., table, 1966.

Between two large dunes near the northern edge of this area on the Rosebud Indian Reservation is an alluviated lowland containing more than 6 m of organic sand and silt. Pollen and seed analyses of the lowest 120 cm imply that a boreal forest with spruce grew there 12,600 C–14 years ago, succeeded by a grassland with perhaps more pine than exists today in the nearby Niobrara River valley and Pine Ridge escarpment. The presence of spruce fossils at the Rosebud site, along with similar finds in northeastern South Dakota and southern Minnesota, implies a late Wisconsin boreal forest over much of the present prairie region. The disjunct stand of *Picea glauca* in the Black Hills may be explained as a relic of a semi-continuous distribution during late-Wisconsin time.—*from* Authors' abstract

5888 **Webb, Fred, Jr.** Geology of the Big Walker Mountain–Crockett Cove area, Bland, Pulaski, and Wythe Counties, Virginia [abs.]: Dissert. Abs., v. 26, no. 10, p. 5979, 1966.

Webster, G. M. *See* Levin, F. K. 5972

Weeks, W. F. *See* Hoekstra, T. E. 5992

5863 **Weiblen, Paul.** Investigation of cathodo-luminescence with the petrographic microscope, *in* Developments in applied spectroscopy, V. 4—Annual Mid-America Spectroscopy Symposium, 15th, Chicago, Ill., 1964, Proc.: New York, Plenum Press, p. 245–251, illus., 1965.

An attachment can be constructed for any electron microscope which allows bombardment of a solid sample surface by the electron beam and simultaneous observation with a petrographic microscope. Cathodo-luminescence is found to be sufficiently specific in multiphase systems to permit identification of major phases, recognition and determination of the distribution of fine-grained and interstitial phases, and investigation of textural features, such as zoning, exsolution, and grain boundary relations. In combination with a photomultiplier tube, the technique could be used to determine the relative amounts of phases in a sample.—Author's abstract

5691 **Weir, G. W.; Gualtieri, J. L.; Schlanger, S. O.** Borden Formation (Mississippian) in south- and southeast-central Kentucky: U.S. Geol. Survey Bull. 1224-F, p. F1–F38, illus., 1966.

The Borden Formation in south- and southeast-central Kentucky is composed of clayey and silty shale, limy and shaly siltstone and siltstone, and cherty, dolomitic, and argillaceous limestone and limestone. These rock types characterize mappable units that in this report are newly named or redefined as members of the Borden Formation, which are the Nancy Member (shale and shaly siltstone), the Cowbell and Halls Gap Members (resistant siltstone), the Nada and Wildie Members (shale and siltstone), the Renfro Member (argillaceous limestone and dolomite), and the Muldraugh Member (cherty and dolomitic limestone, limestone, and limy and dolomitic siltstone). The Borden Formation ranges from about 220 to 450 feet in thickness in this area.—G.W.W.

Weiss, L. E. *See* Patterson, M. S. 5750

Welday, E. E. *See* Baird, A. K. 5730

Wells, Jack S. *See* Martin, James A. 5787

5760 **Wermund, E. G.; Moiola, R. J.** Opal, zeolites, and clays in an Eocene neritic bar sand: Jour. Sed. Petrology, v. 36, no. 1, p. 248–253, illus., 1966.

Opal and the zeolites, clinoptilolite and heulandite, found in the silt and clay fraction of Meridian Sand of middle Eocene age in Mississippi and Alabama are interpreted

to have formed from the alteration of volcanic material. Some of the montmorillonite in the clay fraction has the same origin.—H.A.T.

5820 **Werner, H. J.** Geology of the Vesuvius quadrangle, Virginia: Virginia Div. Mineral Resources Rept. Inv. 7, 53 p., illus., tables, geol. map, 1966.

In this quadrangle in central Virginia the Precambrian granitic and gneissic rocks of the Blue Ridge Complex are unconformably overlain by a conformable succession of Cambrian and Ordovician volcanic and sedimentary rocks exposed in the northwest limb of the Blue Ridge–Catoctin Mountain anticlinorium. Field relationships indicate a continuous deposition on top of an eroded and weathered Precambrian surface, well into Ordovician time. None of the numerous faults are large enough to cast doubt on the nature of the stratigraphic sequence. There is no lithologic evidence of tectonism before Middle Ordovician time. The mineral resources are not of great economic potential, but iron, manganese, and tin ores have been produced; crushed rock, sand, and gravel are currently being produced. The geologic map, in pocket, locates some mines and prospects.—G.D.C.

West, G. *See* Dumbleton, M. J. 5991

5622 **Westheimer, Jerome M.** Geology and petroleum of Love County—Pt. 2, Petroleum geology of Love County: Oklahoma Geol. Survey Circ. 63, p. 5–6, 48–81, illus., table, geol. maps, 1965.

Love County lies in a geosynclinal area characterized by a thick section of Cambrian and Ordovician rocks between the cratons of the eastern Arbuckle Mountains and the Muenster–Nocona arch. From late Mississippian to early Pennsylvanian time the area of the present Marietta basin remained slightly above sea level. Erosion cut as deep as the Ordovician Simpson Group furnishing material for Pennsylvanian sediments. The main producing horizon of the major oil fields, near Enville and Marietta, is the basal Oil Creek sandstone of the Simpson Group. The fields along the Wichita Mts.–Criner Hills trend were folded and faulted in the Wichita orogeny. Other fields produce mainly from lenticular Deese sandstones of Pennsylvanian age. Tilting and counter-tilting probably allowed the petroleum to migrate from gentle anticlines to structures of major uplifts on either side of the basin.—G.D.C.

5573 **Westover, James Donald.** Chromatographic examination of gilsonite [abs.]: Dissert. Abs., v. 26, no. 10, p. 5730, 1966.

Wheat, Margaret. *See* Morrison, Roger B. 5710

Wheat, Margaret. *See* Morrison, Roger B. 5712

5778 **Whipple, Fred L.** Chondrules—Suggestion concerning the origin: Science, v. 153, no. 3731, p. 54–56, illus., 1966.

The millimeter-sized, sometimes glassy spheroids called chondrules that occur abundantly in stony meteorites may have been produced by lightning in the primitive Laplacian-type nebula while earthy materials were condensing and collecting to form the asteroids and the terrestrial planets.—Author's abstract

White, D. E. *See* Doe, B. R. 5649

5973 **White, J. E.** Static friction as a source of seismic attenuation: Geophysics, v. 31, no. 2, p. 333–339, illus., 1966.

A mechanism for energy loss in granular mediums, involving sticking and sliding between grains at areas of contact, is discussed. Previously developed expressions for attenuation in regular packings of spheres attributed all the loss to sliding friction; here the model is extended to incorporate static friction, thus giving an expression for attenuation in better agreement with measured values. The attenuation coefficient for both shear and compressional waves is found to be independent of vibration at low amplitudes; directly proportional to frequency; dependent on the difference between static and sliding coefficients of friction; and dependent on the packing of the granules.—D.B.V.

White, J. L. *See* Mortensen, J. L. 5876

5733 **White, Natalie D.** (and others). Annual report on ground water in Arizona, spring 1964 to spring 1965: Arizona Land Dept. Water-Resources Rept. 24, 62 p., illus., table, 1965.

Extensive development of water supply, particularly in the Basin and Range lowlands province of southern Arizona, has resulted in a downward trend of water levels in nearly all highly developed areas. Greatest declines are in Salt River Valley and lower Santa Cruz basin, the largest agricultural areas in the State. Other areas of large declines include Stewart and Kansas Settlement areas in Willcox basin, Bowie and San Simon areas in San Simon basin, and Avra Valley west of Tucson. Withdrawal of ground water for all purposes was about 4.5 million acre-feet in 1964. Chief use is for irrigation of crops; 1,154,000 acres of land cropped in 1964 was irrigated with ground water, although about 2.6 million acre-feet of surface water was diverted for use also. Ground-water conditions and use of ground water are summarized by areas.—*from* Author's abstract

5634 **White, Walter S.; Denson, Norman M.** Bauxite deposits of northwest Georgia, *with a section on* the Summerville area by John C. Dunlap and Elizabeth F. Overstreet: U.S. Geol. Survey Bull. 1199-M, p. M1-M42, illus., tables, 1966.

Bauxite, surrounded by kaolinitic clay, occurs in ancient sinkholes in the dolomite of the Knox Group. If the clay that was altered in Eocene time to form the bauxite was transported from the Piedmont, the position of Eocene valley bottoms was above 1,100 feet. Areas most favorable for discovery of new deposits are places where surficial debris is now accumulating. Other favorable criteria are alinements due to faults, altitude above 800 feet, proximity to plateau rims and major divides, and proximity to brown iron ore deposits.—W.S.W.

5642 **Whittig, L. D.** X-ray diffraction techniques for mineral identification and mineralogical composition, *in* Methods of soil analysis—Pt. 1, Physical and mineralogical properties, including statistics of measurement and sampling: Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 9), p. 671-698, illus., tables, 1965.

Methods for preparation and mounting samples and orientation of crystals are discussed. Film-recorded and chart-recorded X-ray patterns of the samples should be obtained. One or more patterns of oriented aggregates should be taken with the direct-recording spectrometer for identification of layer-silicate species. The order is given for X-ray examination of layer-silicates. Tables of diffraction spacings are available for identification of species. Identification may also be by direct comparison of diffraction patterns of unknown samples with patterns from known minerals, or measurement of diffraction spacings, and comparison with those of known, standard minerals.—E.L.

Wilcox, L. V. *See* Bower, C. A. 5660

5782 **Wilson, Charles W., Jr.** Annotated bibliography of the geology of Tennessee, January 1951 through December 1960—A supplement to Bulletin 59: Tennessee Div. Geology Bull. 67, 99 p., 1965.

The compilation includes publications overlooked in the preparation of Bulletin 59 (1953) and errata for that volume. All such entries are included in the subject and author indexes.—M.C.M.

5703 **Wilson, Edward C.** Type specimens of fossil invertebrates in the San Diego Natural History Museum: San Diego Soc. Nat. History Trans., v. 14, no. 9, p. 99-130, 1966.

The main part of this catalog is arranged systematically by phyla and a few subordinate categories. In most entries, age and formation are given as they were in their original publication. A species index is included to facilitate location of species-group names in the catalog. Definitions of type categories and concepts as presented by Schenk (1956) and Bell (1962) are followed here.—G.D.C.

5726 **Wilson, Stanley D.; Kaarsberg, Ernest A.** Vibration apparatus for determinination of elastic properties of soil [with German and French abs.]: Felsmechanik u. Ingenieurgeologie, v. 4, no. 1, p. 14–24, illus., 1966.

A vibration apparatus is described that has been designed and used for determination of dynamic elastic properties of soils and slightly consolidated sediments (and probably rocks) at confining pressures corresponding to those at about 150 feet in depth. Cylindrical specimens are enclosed in a rubber membrane and held firmly in contact with a base plate by air pressure inside a pressure tank. Frequency of either longitudinal or torsional vibrations of the base plate is varied until the quarter wave resonance frequency in the specimen is reached. This is observed on an oscilloscope attached to the specimen by pickups at the top and bottom of the specimen. Results are given for a sand, silt, and clay under varying pressure, density, and water content conditions.—V.S.N.

Wilson, William E., 3d. *See* Hawley, John W. 5809

5682 **Winkler, Erhard M.** Moisture measurements in glacial soils from airphotos: Ecology, v. 47, no. 1, p. 156–158, illus., tables, 1966.

Photographs with two commercial aerial films of soil samples from glacial drift established a relation between the tone of airphotos and water content of soils. Optical densities of film negatives, measured with a Weston photographic analyzer, decreased proportionally with added moisture nearly to the Atterberg plastic limit of the soil, but then sharply increased as the Atterberg liquid limit was approached. Although these results do not exactly match moisture amounts inferred from densities of actual airphotos, further studies may yield empirical values useful in some areas.—Author's abstract

5587 **Wohlford, Duane Dennis.** Petrology and structure of Precambrian rocks in the Cache La Poudre Canyon–Livermore area, Larimer County, Colorado [abs.]: Dissert. Abs., v. 26, no. 10, p. 5979–5980, 1966.

5752 **Woldenberg, Michael J.** Horton's laws justified in terms of allometric growth and steady state in open systems: Geol. Soc. America Bull., v. 77, no. 4, p. 431–434, illus., table, 1966.

Rivers are open systems and achieve a steady state or grow allometrically according to equations which reflect a lognormal or Yule stochastic process. Horton's laws are statements of these processes. A new absolute stream order is suggested.—A.G.

5680 **Wood, R. V., Jr.; Enticknap, R. G.; Lin, C.-S.; Martinson, R. M.** Large Aperture Seismic Array signal handling system: IEEE Proc., v. 53, no. 12, p. 1844–1851, illus., 1965.

The signal handling system, whose detailed design is described, involves hardware to collect signals from several sensors, transmit them to processing center, and display and record them, as well as facilities for control of signal sampling and for remote monitoring and testing of its many elements. Some of the instrumentation is illustrated in pictures.—V.S.N.

5758 **Woodring, W. P.** Memorial to Marcus Isaac Goldman (1881–1965): Geol. Soc. America Bull., v. 77, no. 4, p. P53–P56, portrait, 1966.

5921 **Worzel, J. Lamar.** Deep structure of coastal margins and mid-oceanic ridges, *in* Submarine geology and geophysics—Colston Research Society Symposium, 17th, Bristol, England, 1965, Proc.: London, Butterworths, p. 335–359, illus., 1965.

Similarities of continental and island margins of the eastern United States, Bahama Platform, western United States and Chile, and southern Puerto Rico and Hawaii show that a small downwarp or graben fault in the transitional region produces a structure and gravity anomaly similar to those for ocean trenches. Gravity and seismic data have shown that no structures of appreciable depth within the mantle are needed to explain trenches. Possibly trenches are a recent development along flanks of a much older island ridge or continental margin. Talwani and others

(1965) have reconciled seismic and gravity data over ridges by postulating a low-density mass from the bottom of the crust to depths of 20–30 km. Discussion of structures in relation to continental drift and convection currents leads to the conclusion that they do not support these hypotheses.—V.S.N.

Wright, H. E., Jr. *See* Watts, W. A. 5683

5884 **Wyllie, Peter J.** Experimental petrology—An indoor approach to an outdoor subject: Jour. Geol. Education, v. 14, no. 3, p. 93–97, illus., 1966.

Recent developments in experimental petrology are reviewed. Techniques in high pressure and temperature studies are described, and the application of the data to the Earth's interior, metamorphism, magma crystallization, and the nature of ore-forming fluids is discussed.—E.S.L.

5542 **Yochelson, Ellis L.** Mattheva—A proposed new class of mollusks: U.S. Geol. Survey Prof. Paper 523-B, p. B1–B11, illus., 1966.

Recently discovered occurrences of the enigmatic Late Cambrian (Trempealeau) fossil *Matthevia* shed new light on its morphology. Indirect evidence suggests that specimens contained two hard parts, one anterior and one posterior. These heavy pieces may have been an early unsuccessful attempt by a mollusk to exist in a zone of more active water. The morphology of these hard parts is so distinctive that a new molluscan class is proposed to contain animals of this form.—E.L.Y.

York, Derek. *See* Purdy, J. 5965

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5842 **Zimmerman, R. A.; Amstutz, G. C.** The polygonal structure at Decaturville, Missouri—New tectonic observations: Neues Jahrb. Mineralogie Monatsh. 1965, nos. 9–11, p. 288–307, illus., 1965.

Eight different types of structures involving volcanic rocks and having patterns suggesting repeated movement lie on a major fault of continental dimensions, at its intersection with faults and volcanic dikes. Observations on one of these, the Decaturville dome, lead to a working hypothesis that repeated crustal movements played an important part in its formation. Careful study of the structures formed at different times is considered to be the best approach to the interpretation of the origin of such features, including perhaps the Ries and Steinheim basins of Germany.—D.B.V.

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